

AD-A068 764

WOODS HOLE OCEANOGRAPHIC INSTITUTION MASS

F/G 8/3

A PATTERN OF SURFACE COASTAL CIRCULATION INFERRED FROM SURFACE --ETC(U)

APR 52 A R MILLER

N60NR-27701

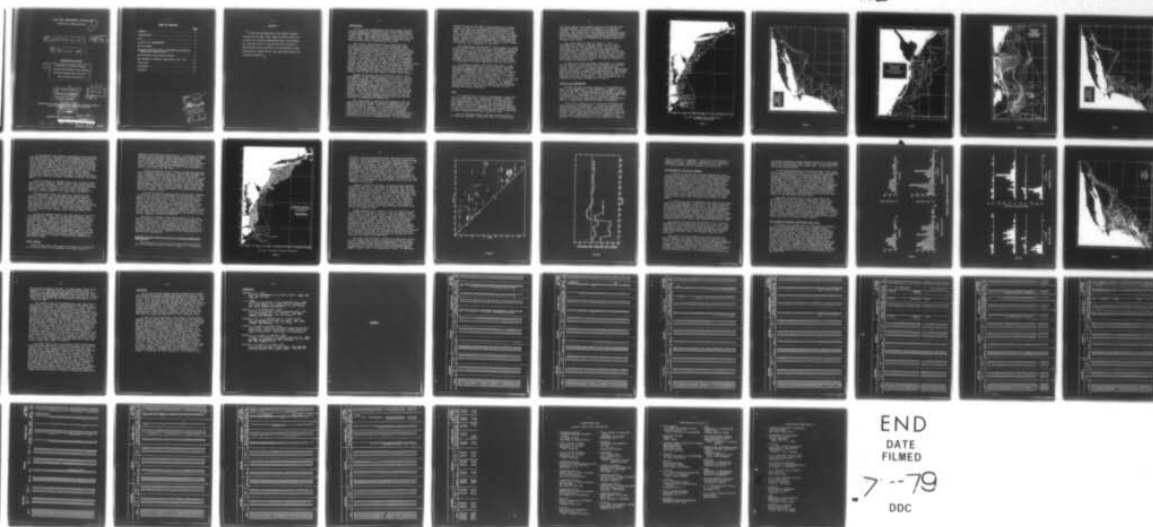
UNCLASSIFIED

WHOI-REF-52-28

NL

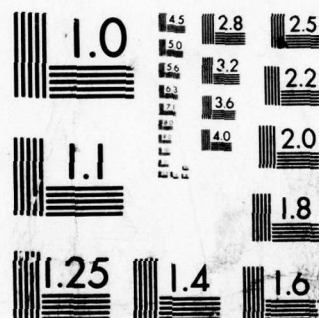
1 OF 1

AD
A068764

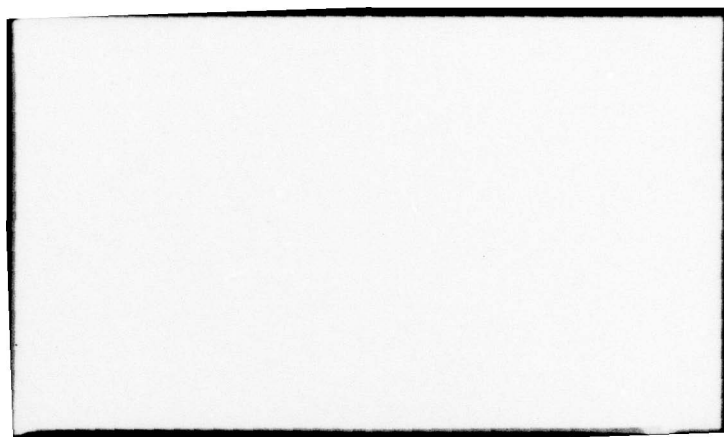


END
DATE
FILMED

7-79
DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

1

14 WHOI-REF-52-28

12 51 p.

9 Technical rept.

Reference No. 52-28

6
A Pattern of Surface Coastal
Circulation Inferred from Surface
Salinity-Temperature Data and
Drift Bottle Recoveries .

By

10 Arthur R./Miller

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

DDC
RECEIVED
MAY 21 1979
A

Technical Report
Submitted to Geophysics Branch, Office of Naval Research
Under Contract N6onr-27701 (NR-084-003)

11 Apr 1952

APPROVED FOR DISTRIBUTION

1042 with
Director

79 05 02 06 381 000 Jm

Table of Contents

	<u>Page</u>
ABSTRACT	1
INTRODUCTION	2
DATA	3
SALINITY AND TEMPERATURE	4
DRIFT BOTTLES	6
RELATION OF DRIFT BOTTLE RECOVERIES TO SALINITY- TEMPERATURE DISTRIBUTION	7
TRAJECTORIES OF THE DRIFT BOTTLES	9
THE PATTERN OF SURFACE CIRCULATION, MAY 1951 . .	10
CONCLUSION	13
REFERENCES	14
APPENDIX	15

ABSTRACT FOR

RTM ☐ NAME SECTION ☐

SEC ☐ EXT. SECTION ☐

EXAMINED ☐

INDEXED ☐

BY *Butler on file*

INSTRUMENT/AVAILABILITY CODE

FILE

APRIL 1951

A

ABSTRACT

↓ A detailed description of the surface coastal circulation for May, 1951, based on drift bottle recoveries and salinity-temperature data is presented. The nontidal drift is traced from Block Island to Cape Hatteras and described as a fluctuating current meandering, forming eddies, and splitting during its southward migration. ↑

INTRODUCTION

To aid in the interrelation of local coastal investigations along the northeastern coast of the United States, a rapid hydrographic survey was made of the coastal water between Block Island and Cape Hatteras within the 25 or 30 fathom curve. The surface circulation is described for the month of May, 1951, from data obtained during the survey and from drift bottle recoveries in the area.

The coastal region between Block Island and Cape Hatteras is characterized by a broad continental shelf sloping gently from the coast to the 100 fathom contour. Its seaward boundary roughly parallels the coastline except near Cape Hatteras where the shelf is considerably narrowed. The edge of the shelf is interrupted by several submarine canyons, most notable of which is the Hudson Canyon. The latter is concerned in this report only where its landward extension, the Hudson Gorge, deeply indents the 30 fathoms contour. The coastline of the area is that of a submerged coastal plain and consists of numerous accessible beaches, spits, and barrier islands with only a few headlands and backshore cliffs. Major river systems breach the coastline at Chesapeake and Delaware Bays and at the New York Harbor Entrance. Runoff from western and southern New England enters the coastal area by way of Long Island and Block Island Sounds.

Surface circulation may be determined directly from measurements of the surface movement of the water. Because of tidal influences, such measurements over a wide area are of little practical use for presenting a detailed pattern of surface circulation. Tidal oscillations complicate the current measurements when the mean motion is sought. The nontidal drift is interpreted as the net result of tidal motion, and, from the rotary nature of tidal currents, the nontidal drift may be only a small portion of the measured current. Since the net result of the total motion of the water is to shift water masses from one place to another, circulation is usually determined indirectly from the distribution of salinity and temperature.

The distribution of salinity and temperature for the region has been discussed at length by Bigelow (1933) and Bigelow and Sears (1935). Prior to spring freshets, the salinity along the coast is at a maximum while the temperature is at its minimum. As one of the basic year-round features of the coastal distribution of salinity, isohalines run more or less parallel to the coastline, with converging of the isohalines and increase in the range of salinity values south of Chesapeake Bay. The mean surface

salinity along the 200 meter (approximately 100 fathoms) contour is 34.1 ‰ (salinity values decreasing shorewards) with February representing the month nearest the mean. The basic parallelism of the isohalines is broken up by considerable variations in salinity about the mouths of rivers and inlets, depending on the discharge of fresh water, and also by compensatory indrafts of high salinity water. There is a general southwesterly drift along the coast which is borne out by the fact that no major changes in salinity occur lengthwise of the shelf.

The temperature distribution is more subject to change in the coastal water than salinity, particularly during the spring season. As the surface water is warmed, producing a shallow thermocline, the vertical strata become increasingly stable, inhibiting the turbulent transfer of heat downwards. Stability of the vertical column is further increased due to spring freshening. Thus, between April and May, the surface water may absorb heat to the extent of increasing the surface temperature as much as 4 to 6°C.

According to Bigelow, the first three weeks in May make up the transitory period in which winter-type water (vertically homogeneous water with tendencies towards increased temperatures near the bottom) changes to summer-type water (vertically stable water, much colder on the bottom). In addition to the local changes in the coastal water, there are effects of transport in and out of the area. Drifts from the east or northeast may act as chilling or warming agents, the former if the drift is longshore, the latter if the drift is from offshore. For example, Bigelow mentions recurrent cold surface intrusions spreading west and south from Cape Cod but seldom, if ever, passing the offing of New York.

DATA

In a region with a variety of hydrographic conditions such as those described, considerable detailed observations are required. This requirement is stressed during the transitory month of May, for, not only are detailed data needed, but, in view of the rapidly changing state, data should be acquired synoptically. With this objective, the cruise of the R. V. ALBATROSS III was planned to obtain as much detailed hydrographic information over a large area as could be gathered in a short period of time.

Most of the hydrographic data were collected while the ship was underway. Subsurface data (to be dealt with

in a later report) were obtained with the Sea Sampler and Bathythermograph, instruments designed to be used while underway, interposed with a few standard hydrographic stations. The surface data were acquired with the Salinity-Temperature-Depth Recorder, a continuously recording instrument which measures the temperature and conductivity of sea water. Drift bottles were released at periodic intervals throughout the cruise.

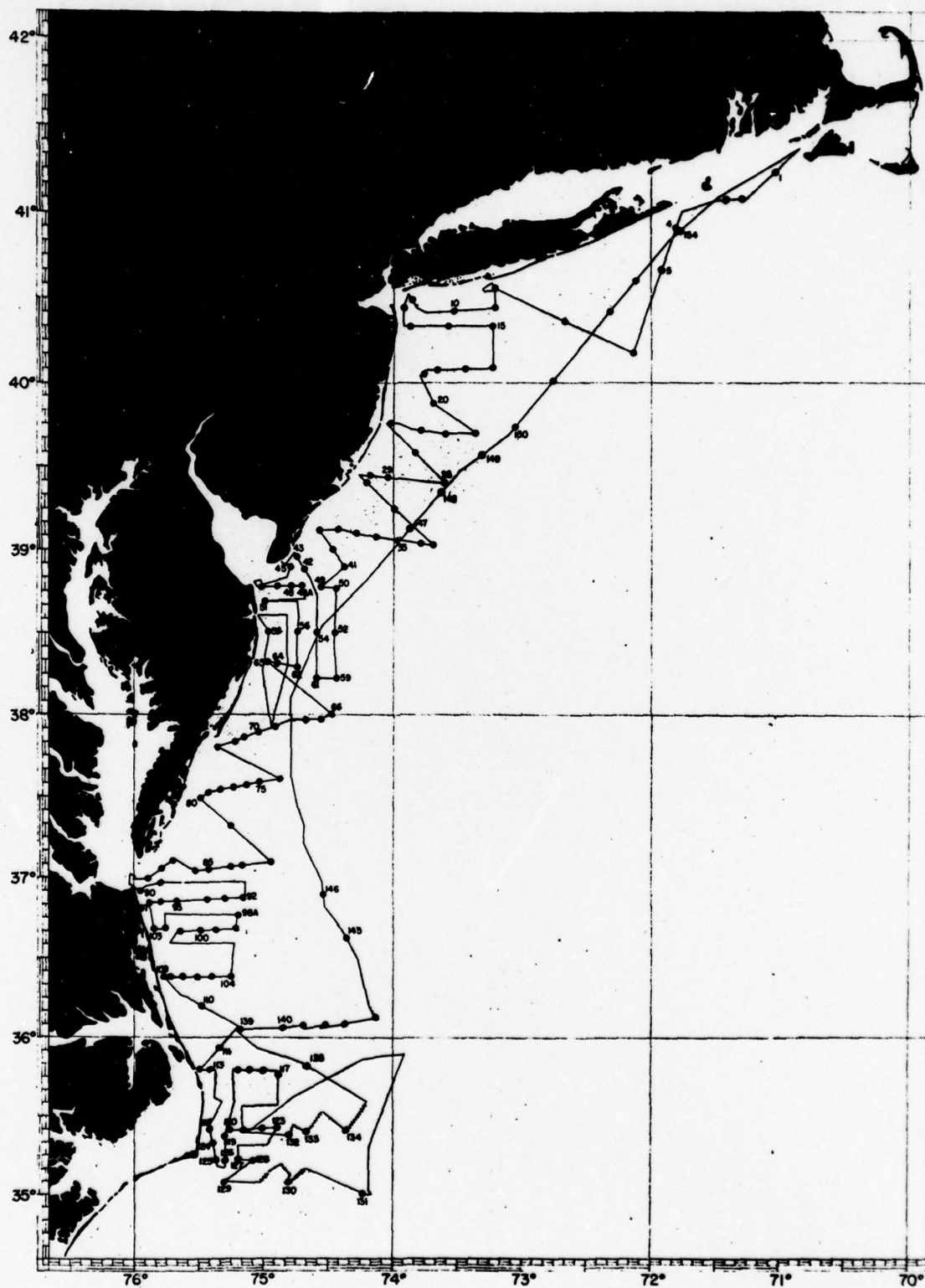
The cruise plan is shown in Figure 1. The R. V. ALBATROSS III followed a zig-zag course, more or less, from near shore to the 25 fathom curve. At the end of seven days at sea, the inshore work was completed and investigations were carried out into deep water as far as the Gulf Stream. Connected points during the cruise served as checks on the synoptic character of the survey. In some localities changes over a lapse of time were observed but these were not sufficient to alter the general treatment of the survey as a composite unit.

At any point along the track, measurements of salinity and temperature at the surface were available from the STD record. Whole values of salinity and temperature were plotted over charts of the ship's track and were interpolated wherever necessary to maintain continuous plots. The plotted values were uncorrected for consistent errors and were somewhat less than the actual values. The surface plots of salinity are shown in Figures 2, 3, and 4; surface plots of temperature are shown in Figures 5, 6, and 7.

SALINITY AND TEMPERATURE

Perhaps the most striking feature of the salinity diagrams is the meandering of the isohalines. Bigelow attributes the variance from parallelism of isohalines to indrafts of salt water from offshore balancing the seaward migrations of fresh water. Supposing this to be the case for May, 1951, the coastal water is broken up into numerous offshore-onshore drifts which, superimposed over the coastwise drift, lead to a complicated pattern of surface circulation.

The 31 ‰ isohaline can be traced at intervals from Block Island to Cape Hatteras. It serves as a convenient boundary between coastal water and water freshened by the local river systems. In this report coastal water will be defined as water having salinity values between 31 ‰ and 34 ‰. The coastal area between Block Island and the New Jersey coast is bounded by the 31 ‰ isohaline. The gradient of salinity adjacent to this isohaline is weakest



TRACK CHART - ALBATROSS III - CRUISE A40 - MAY 8-20, 1951.
DRIFT BOTTLE RELEASE STATIONS

FIG. I

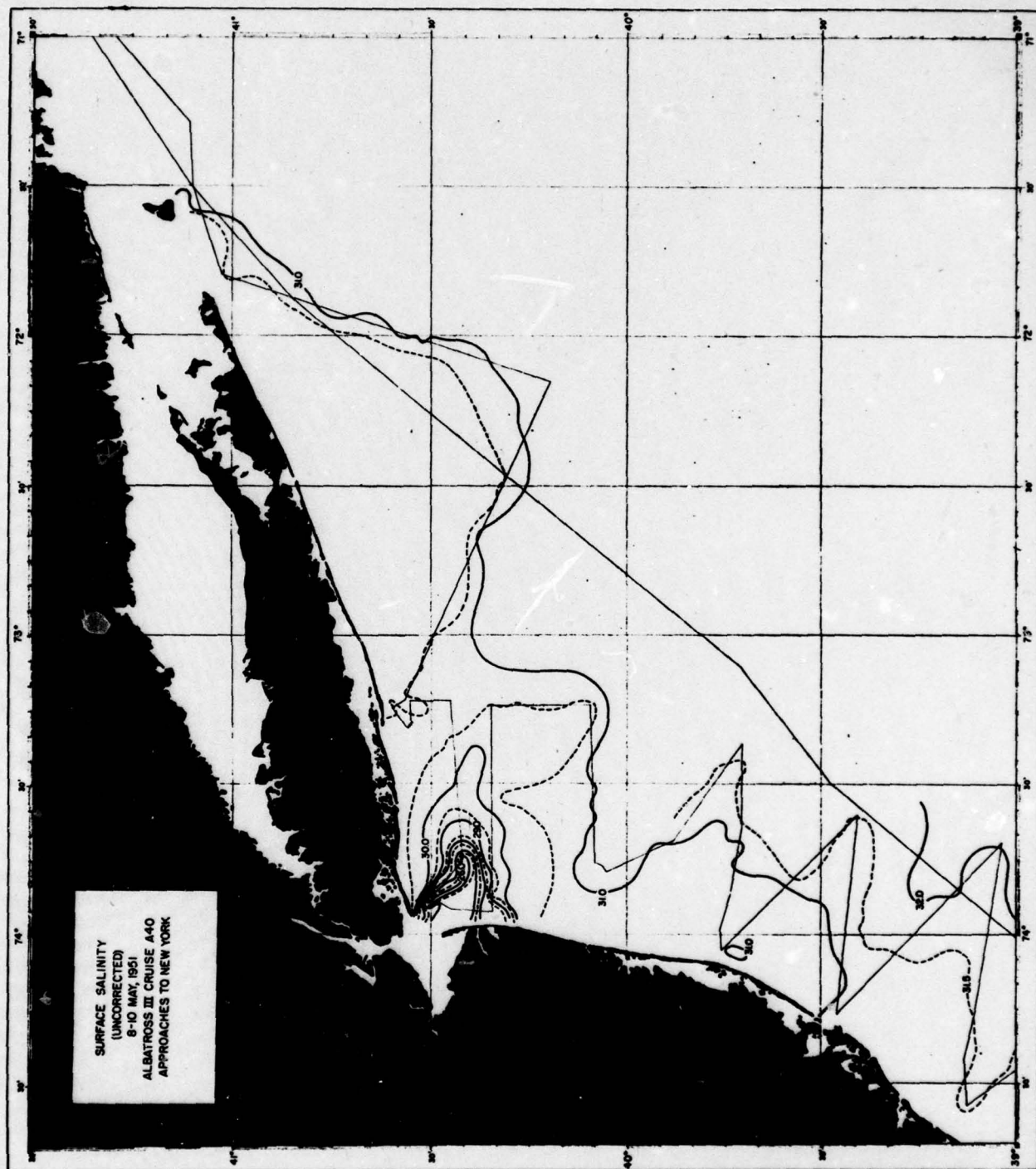


FIG. 2

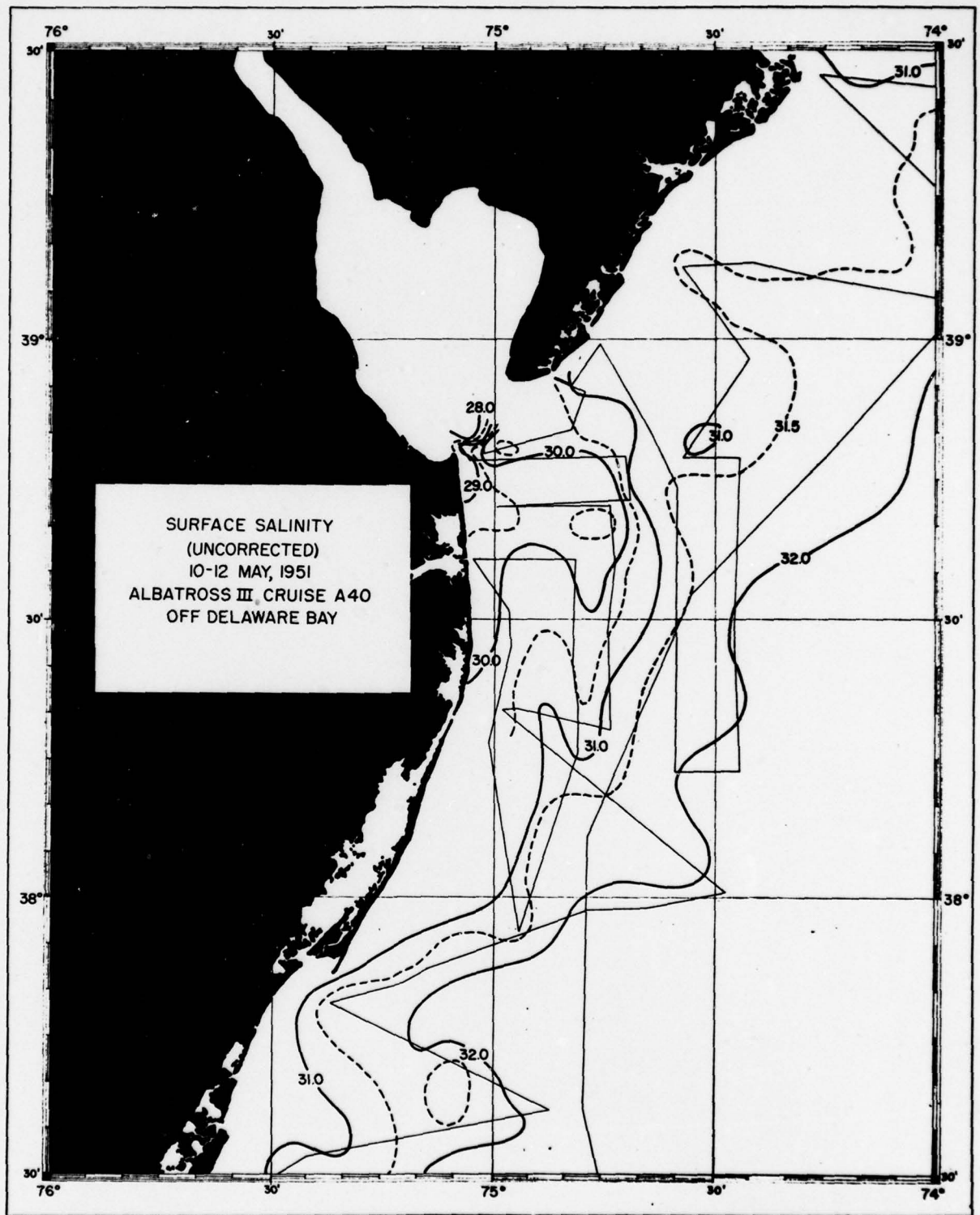


FIG. 3

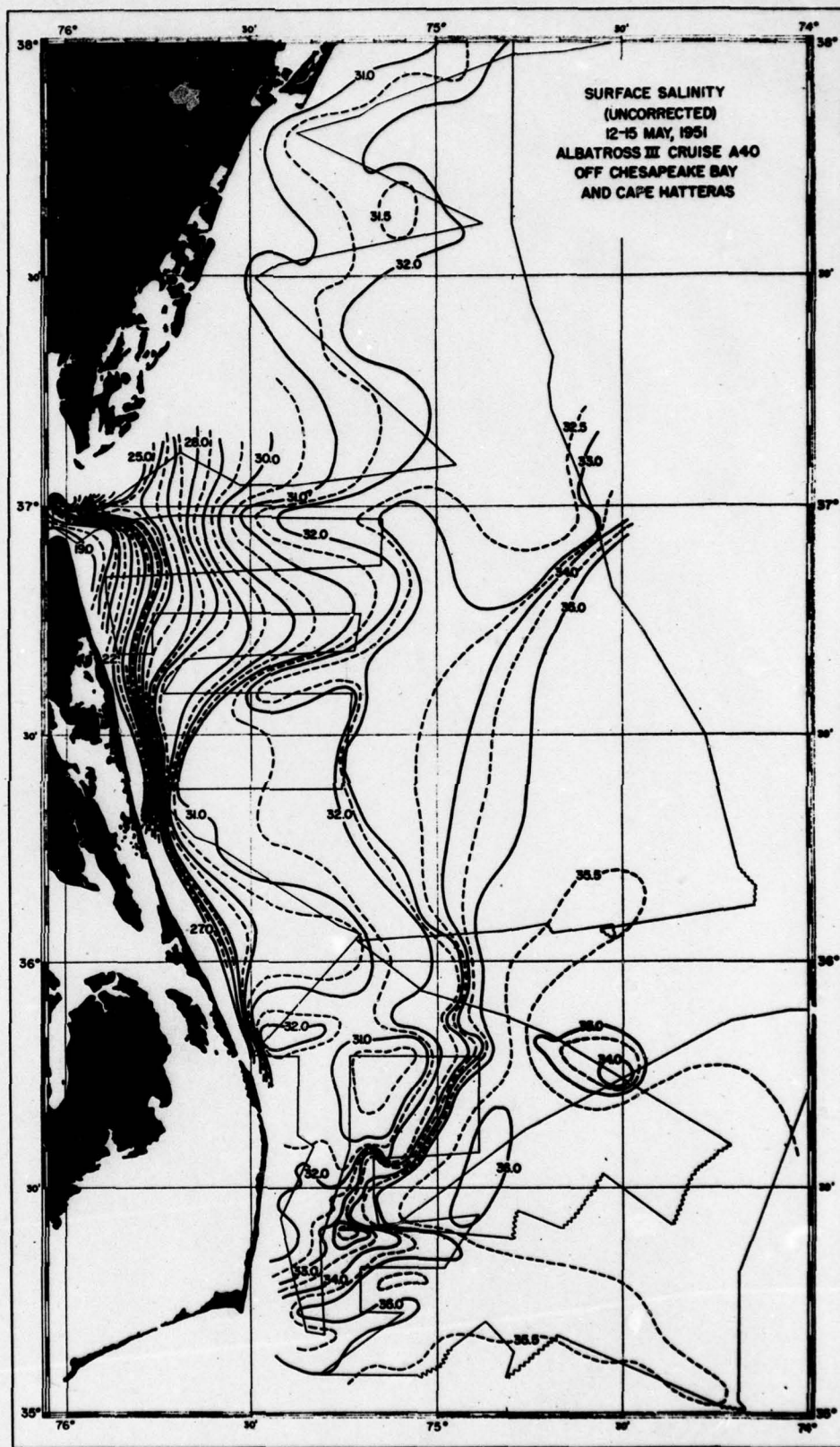


FIG. 4

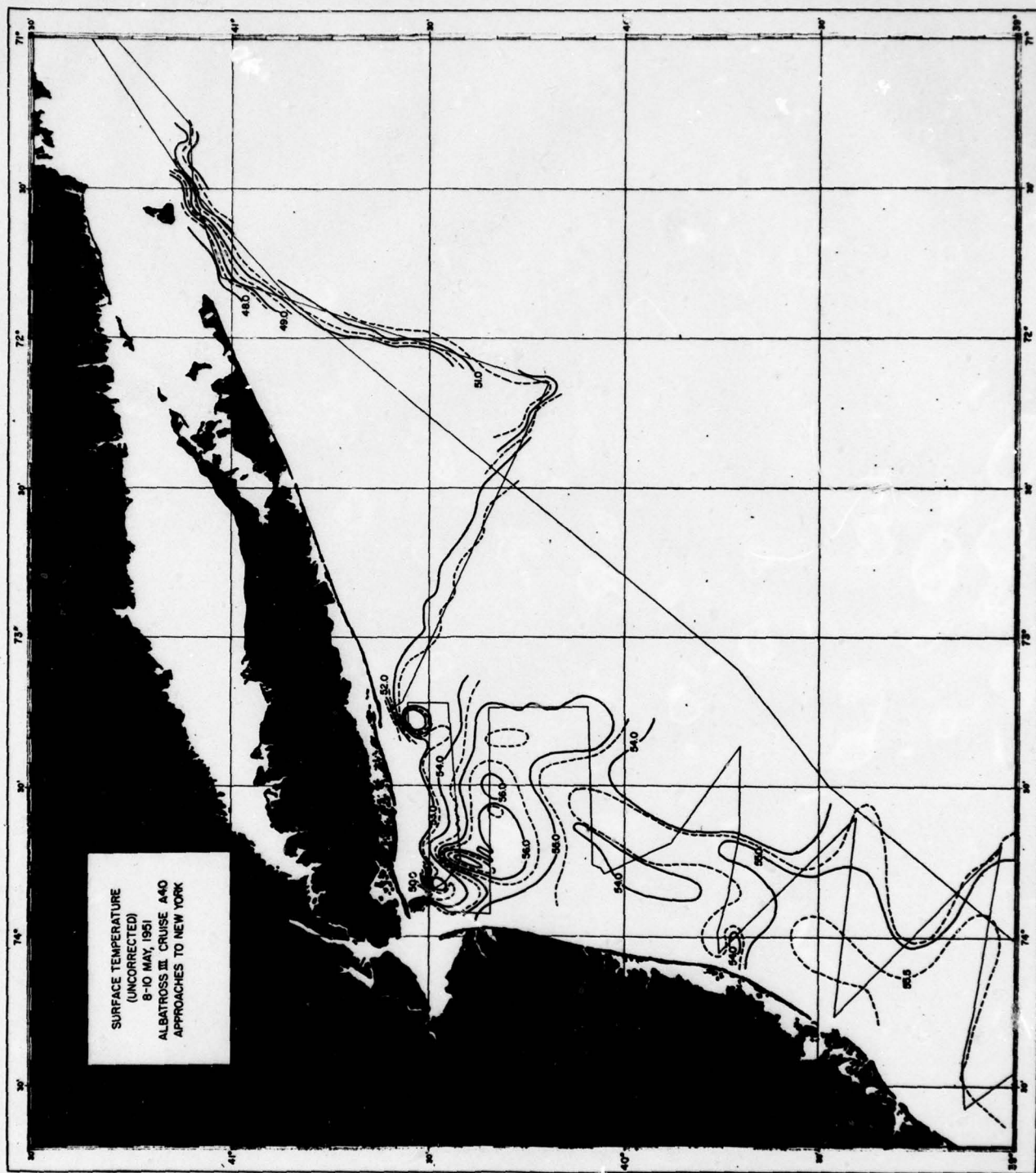


FIG. 5

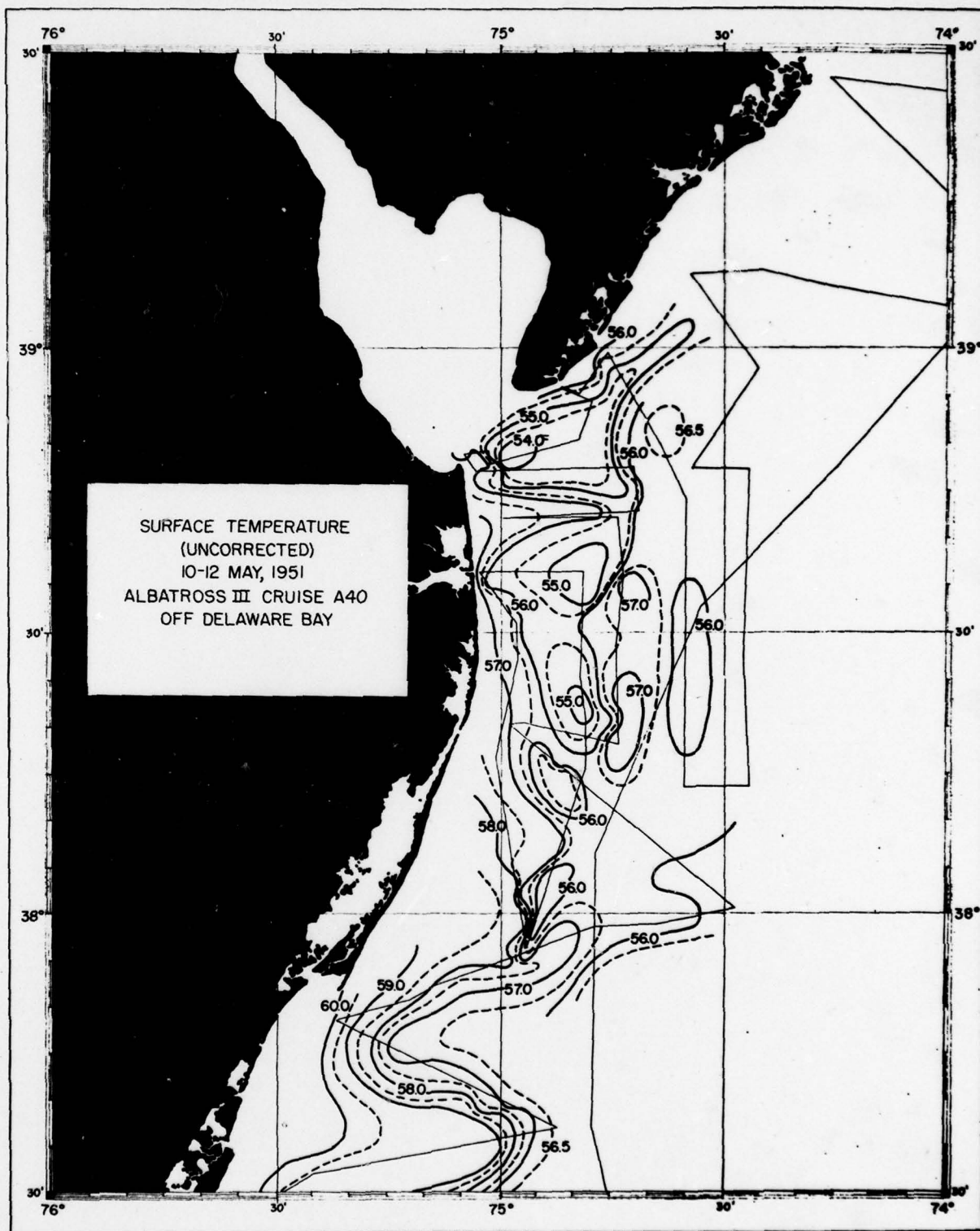


FIG. 6

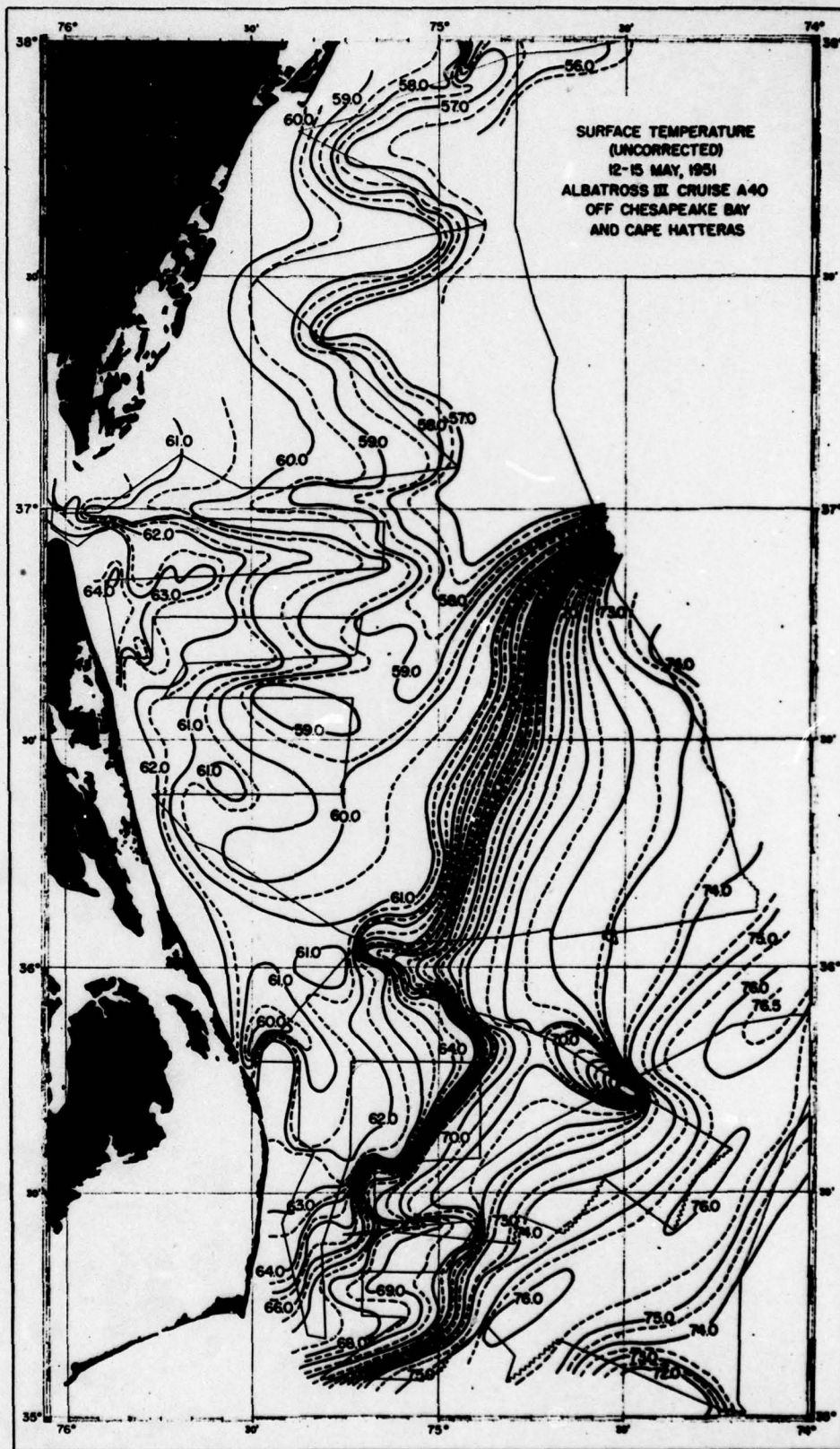


FIG. 7

in an area east of the New York Harbor Entrance and in another area south of the harbor. Well mixed river-freshened water is apparently flowing out of Block Island Sound and spreading seawards in a southwesterly direction. The spread of this low salinity water is limited and its effect vanishes or becomes indistinguishable southeast of Fire Island Inlet. Here a tongue of saline water, nearly coastal in character, extends shorewards and enters the western reaches of the Long Island shore where it meets the effluent leaving New York Harbor. The Hudson River effluent extends seawards for 20 to 30 miles to be confined again by another indraft of coastal water from the southeast. South of 40° , freshened water appears in limited amounts along the New Jersey shore until it disappears completely at $39^{\circ}30'$.

North of Delaware Bay coastal water hugs the coast and even encroaches upon the mouth of the bay itself. The Delaware effluent is apparently well mixed and comparatively small in volume. It extends seaward for a short distance and also extends south along the shore. An indraft of coastal water from the south tends to separate the seaward and shoreward drifts. The 31 ‰ isohaline encloses a relatively narrow band (20 miles wide) of freshened water that extends from Cape May to Chincoteague Inlet.

At Chesapeake Bay the water undergoes a distinct change. The salinity of the effluent is as low as 19 ‰ and salinities < 31 ‰ are observed well to seaward. The effluent is apparently split during its eastward migration by an indraft of coastal water. The river-freshened water is traceable northeast of the bay entrance, but is most prominent to the south and southeast. Considerably freshened water of < 27 ‰ salinity extends south as far as Oregon Inlet. An increase in velocity in this area is probable, due to the constriction of fresh water flow resulting from the effects of coastal water indrafts. At Cape Hatteras, the coastal water becomes part of the oceanic circulation. Its off-shore movement is marked by sporadic tongue-like extrusions into regions of high salinity.

The continuity of the temperature distribution for May, 1951, is not as clear as the salinity distribution. In many instances, isotherms have to be drawn as isolated pools. In comparison with Bigelow's data, one might assume that vernal warming was somewhat earlier than usual in 1951. Generally, surface temperatures were 2 to 4°F . warmer than the warmest chart of temperature presented by Bigelow for the month of May.

In the New York area maximum temperatures were recorded near the entrance to the harbor. This maximum coincided with the indraft of saline coastal water already mentioned; however, the warmer temperatures are not continuously traceable to the offshore regions. The coldest water in this area was found along the Long Island coast. The fact that this water is also saline suggests that its origin is probably from the Block Island area. The temperature distribution for the New York area, although warmer than Ketchum's April survey, corresponds closer to the observed winter distributions. January and February surveys show wedges of warm water entering the area from the southeast (Ketchum, Redfield, and Ayers, 1951).

Off the entrance to Delaware Bay a pool of water colder than 54°F . was observed. Further south, cool water from the bay is interposed between 57°F . water. South of Chincoteague Inlet there is a reversal in the horizontal temperature gradient. Water is warmest near the coast, in contrast to the New York area, where it is coldest near the shore.

The warm water along the coastline continues as far south as Currituck, below Chesapeake Bay, where another gradient reversal takes place and the warmer surface water lies offshore. In this area maximum inshore temperatures lie just south of Chesapeake Bay Entrance. The indraft of high salinity coastal water which contributes to the southerly flow along the coast north of Oregon Inlet brings with it chilled water from the north. In the Cape Hatteras region the cold coastal water intrudes upon the warm oceanic circulation.

In its most general aspects the distribution of salinity and temperature for May, 1951, is not much different from previous May data. However, the detailed distribution shows considerable meandering of the isohalines and isotherms and allows a finer interpretation and delineation of the water masses. The continuous nature of the data permits an effective analysis of the probable origins of the water masses and their general movement during the time of survey. From the combination of the salinity-temperature analysis and the direct measurements from drift bottle data which are assumed to represent the results of nontidal surface transport, a reasonable pattern of surface circulation was developed for the month of May.

DRIFT BOTTLES

Drift bottle data, when applied to studies of the motion of the surface layer, are sometimes confusing because of

apparently contradictory trajectories. In the Gulf of Maine, Bigelow (1927) resolved conflicting data into rational order by assuming curved drift bottle trajectories which traced out the counterclockwise circulatory system of that area. Within the seeded area (Gulf of Maine) the drift bottle data were sufficient to justify the manipulation of the trajectories. It was more difficult to justify the adjustment of drift bottles that left the area.

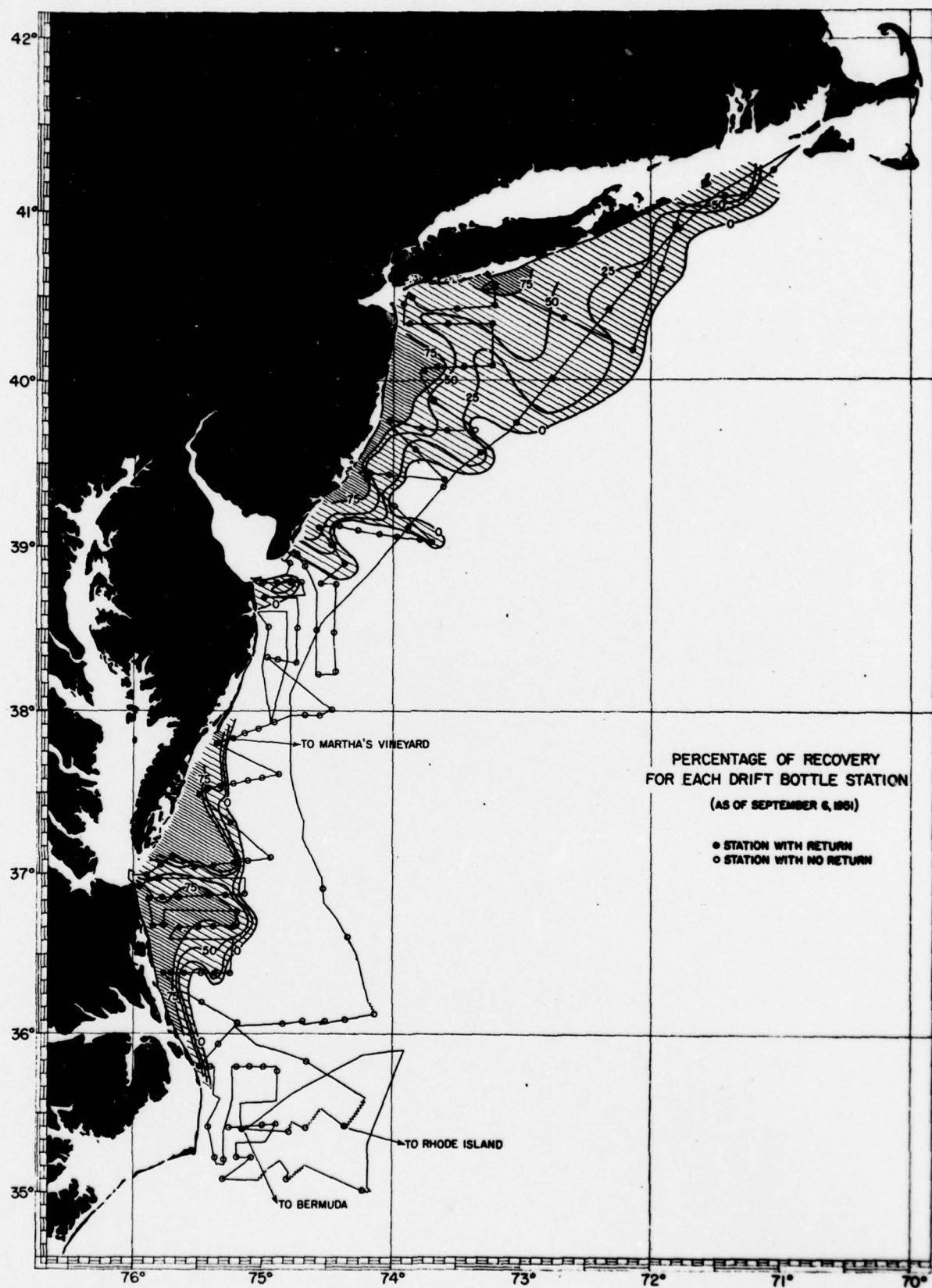
Bottles set adrift in the vicinity of Cape Cod (Bigelow, 1927) stranded along the shores of southern New England, New York, Virginia, and North Carolina, more or less in that order according to the distance they were set offshore. From recent investigations (Redfield and Walford, 1951) a similar order of recovery is to be expected off the entrance to New York Harbor. Bottles set adrift 10 miles from the beach may strand between Cape May and Cape Hatteras, while those within the 10-mile limit may be beached locally. More recent data (Powers and Ayers, 1951) show marked differentiation between local and distant returns.

A closed circulation such as occurs in the Gulf of Maine is suited to the task of adjustment of trajectories. The coast to the west and south of Cape Cod is less suited, for, within a short distance of the coast, bottles will usually drift out of the local area. Once a bottle has left the seeded area, the difficulties in adjusting the drift of the bottles to rational order increase while justification for the manipulation becomes vague. It is fortunate that, in the present study, the entire coastal region from Block Island to Cape Hatteras was well-distributed with drift bottle stations. Thus, the recoveries supplemented one another in tracing the longshore surface circulation.

The chart in Figure 1 shows the positions of the drift bottle stations. In all, 1,740 bottles were released in lots of 12 at 145 stations. These were plain 12-ounce bottles that were ballasted to float upright in sea water with only a small portion of the neck appearing above the surface. As of August 30, 1951, 478 bottles had been returned from 73 stations, that is, 27.6 % recoveries from 50% of the stations. This excellent return was compared with the distribution of salinity and temperature.

RELATION OF DRIFT BOTTLE RECOVERIES TO SALINITY-TEMPERATURE DISTRIBUTION

The percentage of onshore drift bottle recoveries from each drift bottle station is shown in Figure 8. As would be



TRACK CHART - ALBATROSS III - CRUISE A40 - MAY 8-20, 1951.

FIG. 8

expected, stations with greater than 75% return are nearest to shore, and diminishing returns are indicated progressively offshore. Lower percentages are shown leading inshore to the mouths of the estuaries. For instance, minimum return is indicated well in toward the entrance of New York Harbor. This agrees with similar indications in the area from other experiments (Redfield and Walford, 1951). Lack of returns is conspicuous off Delaware Bay; those bottles which were recovered from this area beached in the vicinity of Cape Hatteras. In contrast, practically all of the stations off New York produced recoveries. The general correspondence of the lines of recovery with the isohalines (30 ‰ to 32 ‰) suggests a relationship of onshore surface drift with the distribution of salinity.

Figure 9 shows the latitude of release plotted against latitude of recovery. The figure illustrates that very few bottles drifted to the north and, in any case, only drifted a few miles in that direction. It is apparent that the large number of recoveries from the New York area is accounted for through long distance drifts. The local recoveries were from nearshore stations. The longest drifts of the recovered bottles were from sets between 38°30' and 40°N. Generally, the bottles released in coastal water (>31 ‰) drifted the greatest distance, while the short drifts were made by bottles released in river-freshened water. Both long and short drifts come ashore above Cape Hatteras with only a few bottles rounding the Cape.

Rough computations of density (σ_t) were made for place of recovery of each drift bottle in order to compare these values with the density of release. The differences in these density values were classed and averaged for intervals of 10 miles of distance traveled. These differences are shown in Figure 10 for recoveries during the first and second week of being cast overboard. Within the first week, bottles stranded in regions of greater density than release; within the second week, bottles also stranded in regions of greater density but with less differences. The differences of density also decrease generally according to the distance traveled. It is worthy of note that the average difference in density (σ_t) between release and recovery was 2.4 during the first week and 0.2 during the second week.

The above data indicate a tendency for the drift bottles to float along lines of equal density and indirectly along lines of similar salinities and temperatures. If the slope of the sea surface were known and were associated with the distribution of surface density, the above relation would suggest surface flow in the geostrophic sense. In addition,

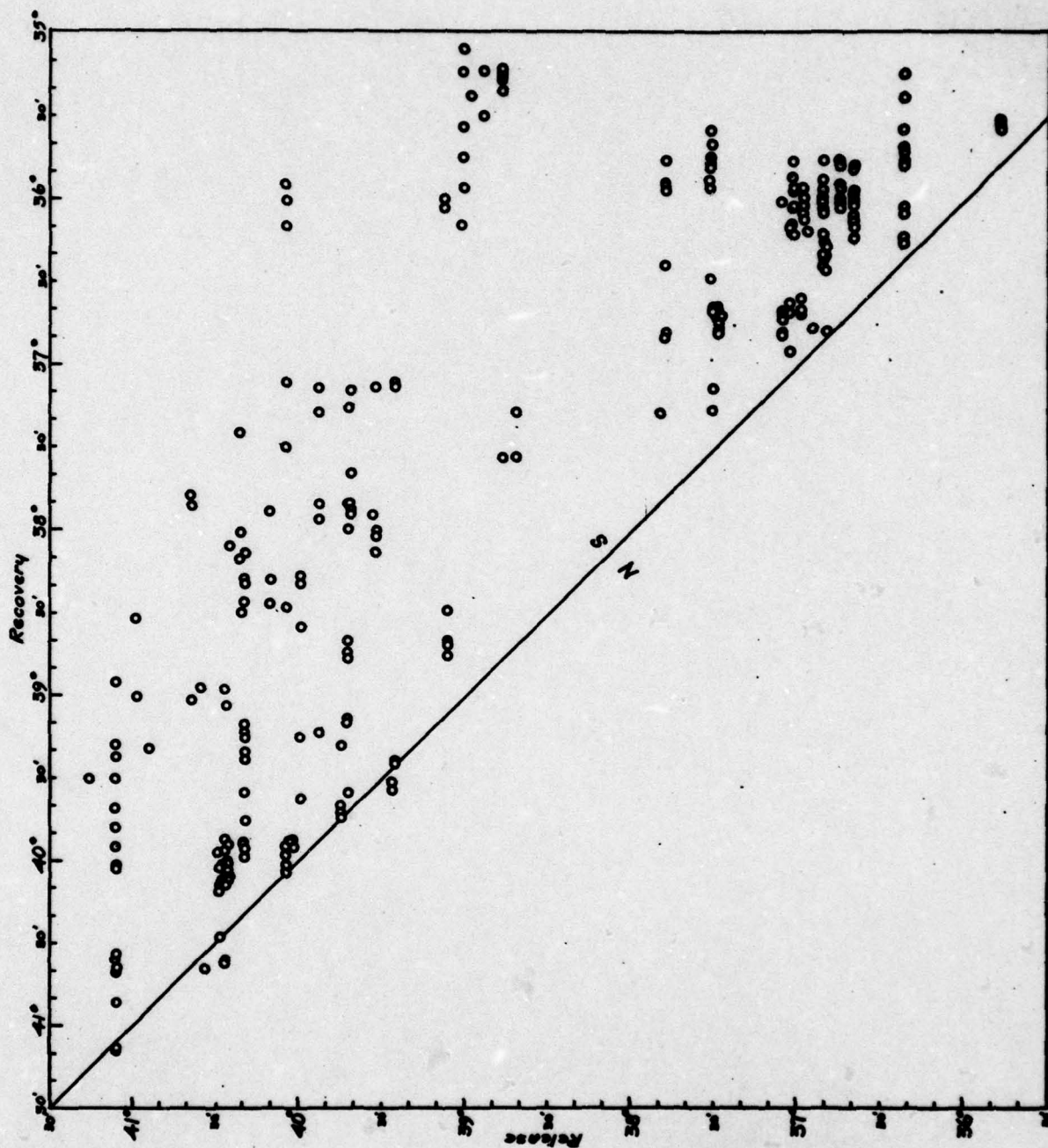


FIG. 9

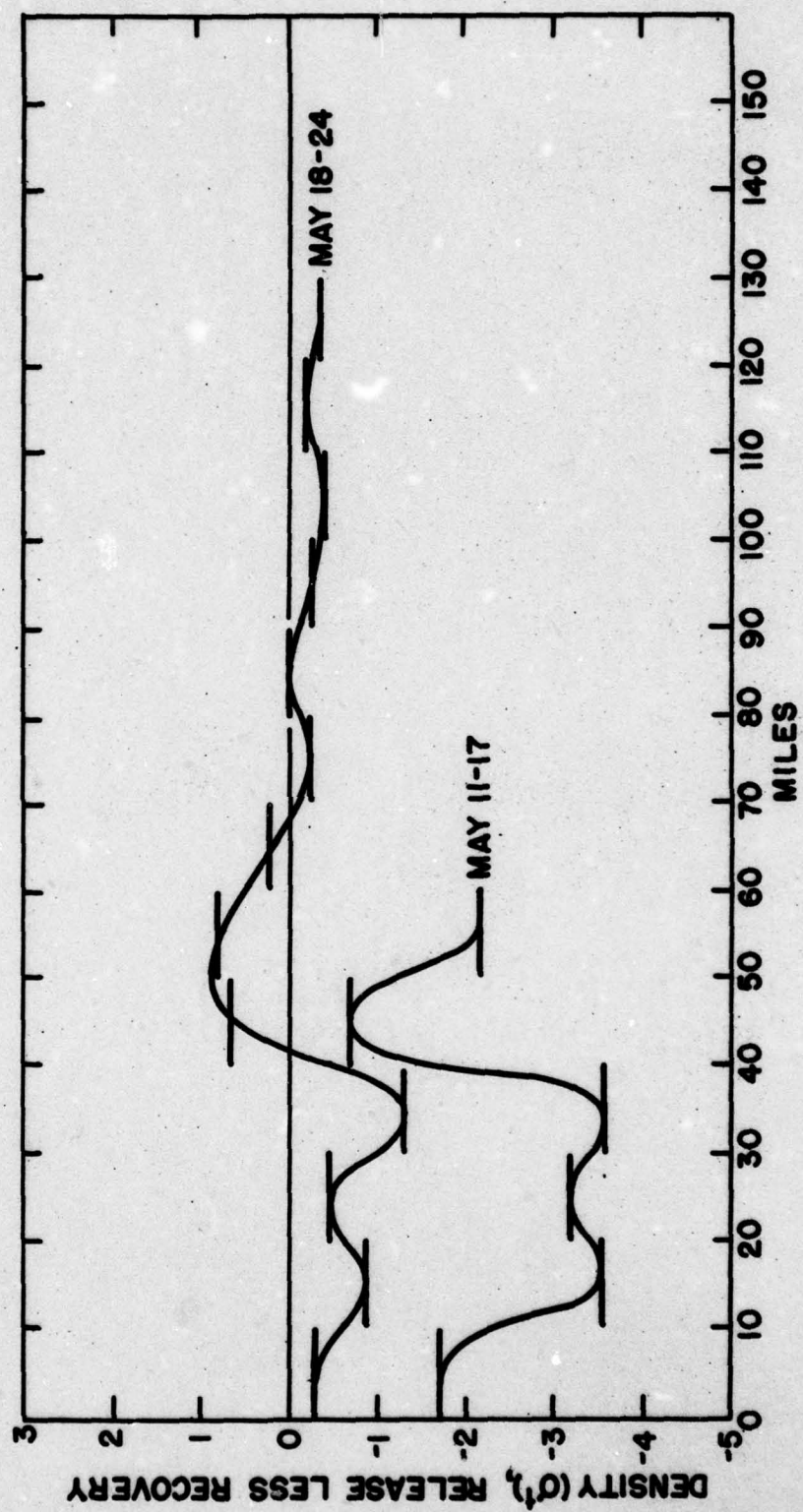


FIG.10

there is probably a component of drift in the direction of greater density or downslope. Apparently, this downslope component is small compared to the total drift, but it is not known whether this is a general or local effect.

TRAJECTORIES OF THE DRIFT BOTTLES

If we are to obtain more detailed information of the surface drift through the use of drift bottles, we must make certain assumptions in order to adjust the minimum values. The degree of certainty in which the actual drift is represented will depend on the validity of these assumptions. The basic assumptions involved in this study are concerned with velocity and distance. In general, velocities are assumed to be approximately the same within a given area. A trajectory is assumed to follow the shortest path between place of release and recovery without conflicting with other trajectories. It is assumed that the paths or trajectories of the drift bottles are restricted to a minimum of crossings and that, in no case, do paths cross normal to each other.

In addition to these assumptions, two other factors were taken into consideration. First, it is not known how long a bottle had been stranded on the beach. The time factor is uncertain within limits, but due to the excellent percentage of recoveries and the particular area which was surveyed, the time of stranding was assumed to be within a day or two of the time of recovery. Second, the question of wind effect upon the individual bottles has been considered only as of relatively minor importance. Previous experiments have shown no appreciable affect due to wind (Webster and Buller, 1950).

The problem of adjusting trajectories to fit the basic assumptions is essentially one of trial and error until all criteria are fulfilled within reason and little or no inconsistencies remain. Paths were drawn, measured, and redrawn using facts and inference, starting from the best known to least known material, until the ultimate objective was achieved.

The paths of bottles representing quick returns over short distances were drawn first, then the paths of neighboring bottles from nearby stations were tentatively adjusted to fit the basic assumptions, either in rate of travel, or distance traveled. Usually, when distance traveled was changed by distorting the paths, the resultant rate of travel for that particular bottle fell in line with those of the initial reference bottles. If recovered bottles from a line

of stations apparently passed through another line from which there were no returns, it was obvious that their trajectories had to be detoured around the second line. In this way, the paths were reconstructed.

It has been assumed that velocities within a given area should be reasonably consistent. In other words, the presence of a definable current may be characterized by velocities within a definite range. A frequency diagram, Figure 11, illustrates the minimum drift velocities before and after adjustment. These velocities are classed according to distance traveled. The number of initial minimum velocities are distributed at random over a wide range. Upon adjustment of the trajectories, definite maxima appear in the diagram. This same tendency occurs if the diagram is again redrawn and classed according to the area in which the bottles were set adrift (Figure 12). Characteristic model velocities appear for the New York and Chesapeake area which were less clear for the unadjusted minimum values.

Apparently reconstruction of the trajectories was sufficient to satisfy the basic assumptions. While there is no assurance of the reality of the deduced paths, one can assume a general correspondence to the actual drift. The provisional interpretation of flow in the geostrophic sense served as a guide for checking the interpolated paths of the drift bottles. Figures 13, 14, and 15 show the deduced trajectories. The arrows in the figures represent the direction of drift inferred from salinity and temperature. In this way a consistent pattern of surface circulation was obtained within and beyond the onshore drift pattern.

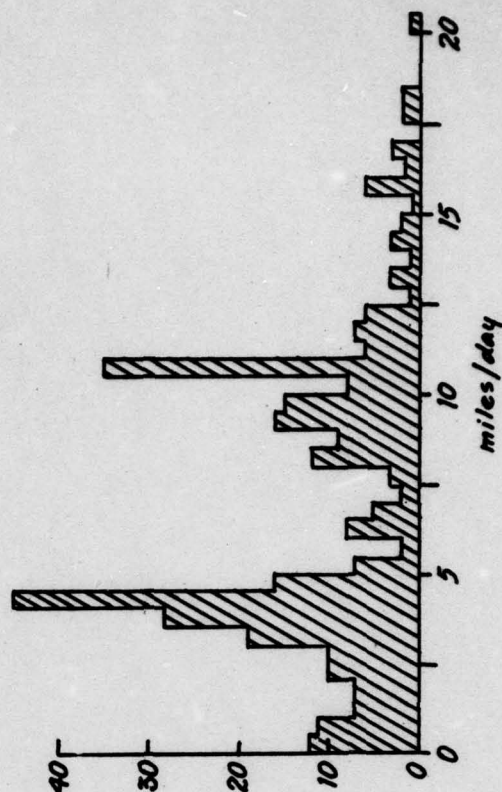
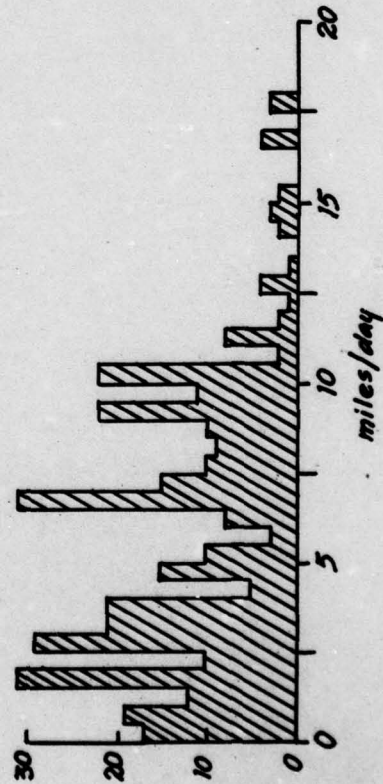
THE PATTERN OF SURFACE CIRCULATION, MAY, 1951

Generally, the coastal drift is unmistakably southward as far as Cape Hatteras but here the southward trend immediately ceases and the drift turns east or northeast. The southerly drift is not direct or confined in the sense of a broad slow current. It meanders, divides, eddies and otherwise shifts as evidenced by the distribution of temperature and salinity. Since the nontidal motion appears to be a function of density, the effective drift due to fresh water contributors may be a large factor in their particular localities. Estimates of surface velocity in local areas are limited to establishing an approximate minimum speed. From these estimates, one can expect the velocity of the surface drift to be as much as 20 miles per day south of Chesapeake Bay and as little as 3 miles per day in the New York area.

No. > 75 miles travel



No. < 75 miles travel



Minimum Velocities

Adjusted Minimum Velocities

Frequency Diagram for Recovered Bottles.

FIG. 11

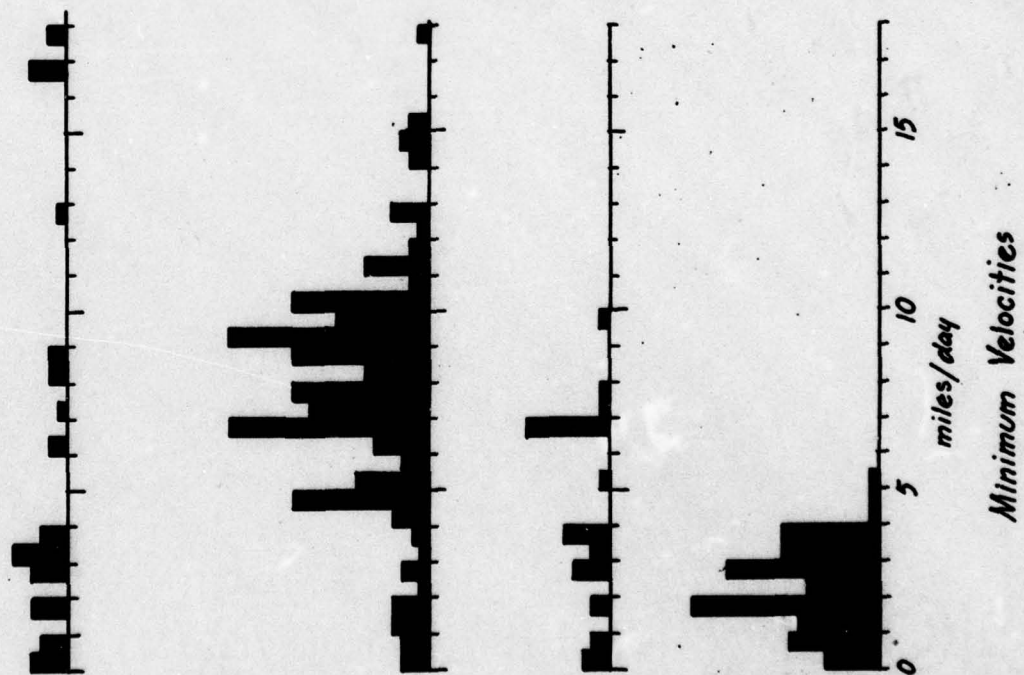
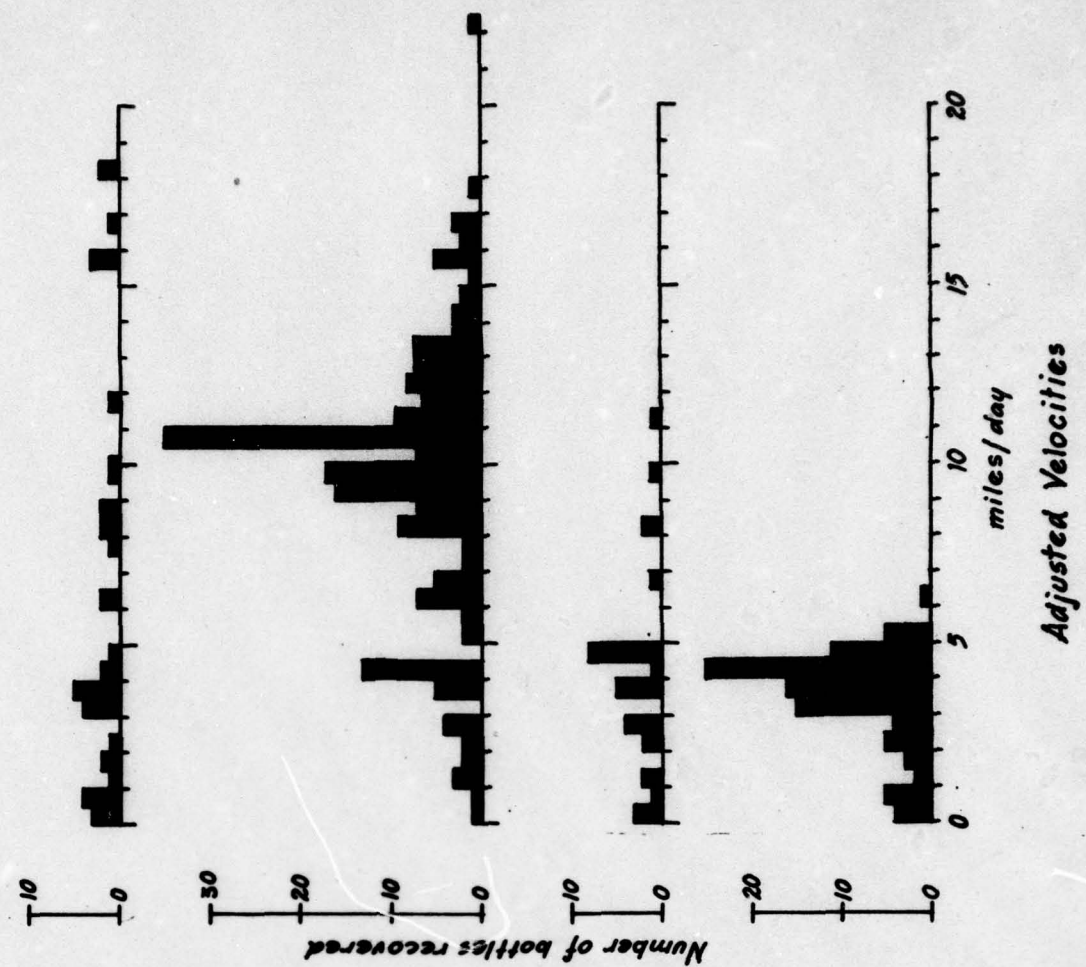


FIG.12

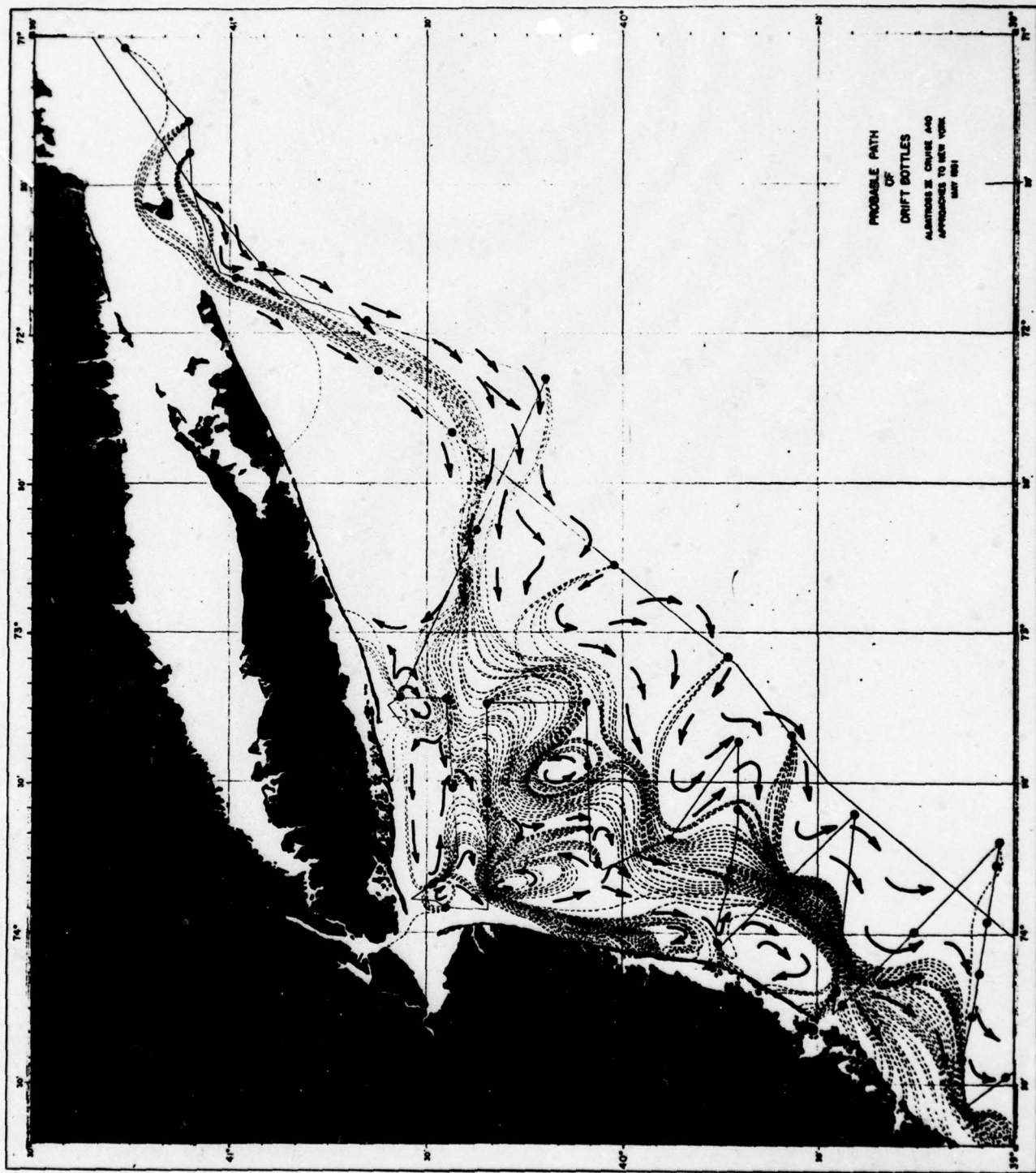


FIG.13

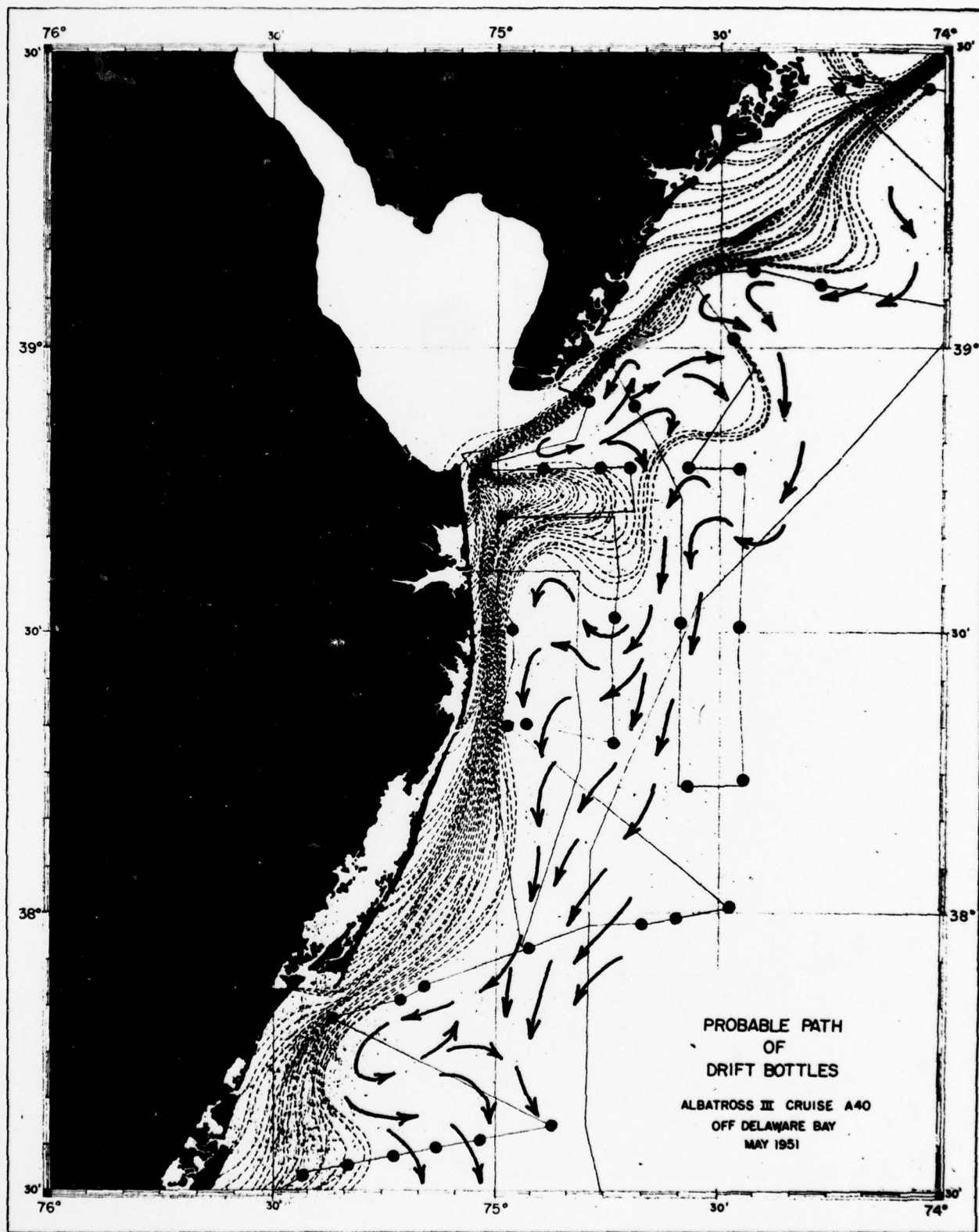


FIG.14

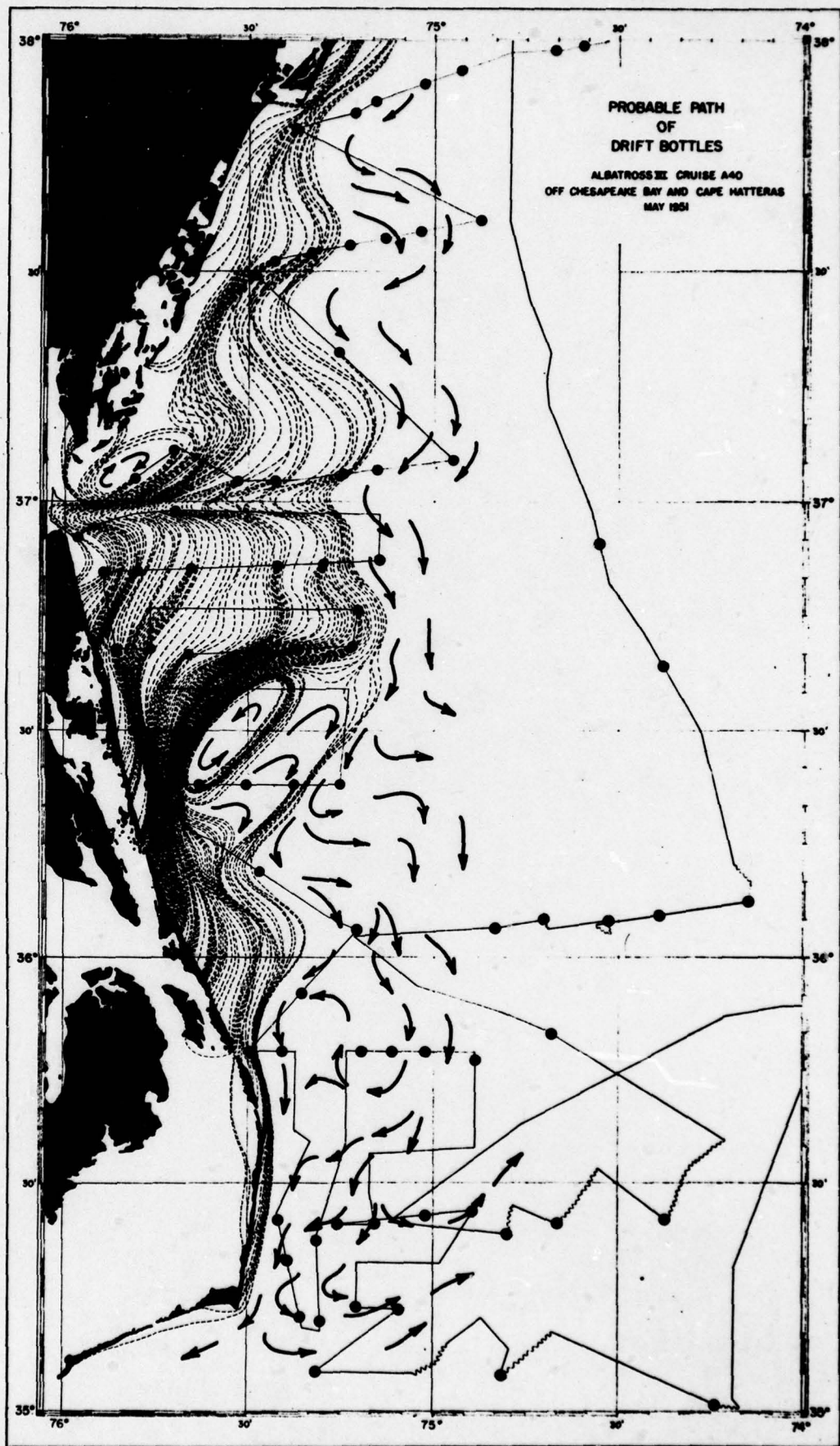


FIG.15

Off New York, the pattern of surface circulation showed a somewhat confined current heading seawards from the eastern end of Long Island in a southeasterly direction. Its probable velocity was 4 to 5 miles per day. East of the 73° meridian this current had probably speeded up slightly with an indraft of saltier and warmer water. At about the same meridian the current diverged upon meeting the outflow from the harbor. One branch led to the north of this outflow and further split up into two eddies near Fire Island Inlet and the lower reaches of Long Island. The southerly branch joined the harbor outflow directly and was carried seaward as part of the local current.

The effluent from New York Harbor extended seaward for a distance of 20 to 30 miles and entrained cold, saline water on the north. At the same time, the fresher water was returned towards the coast westerly and southwesterly. The return to the coast of the river effluent was split by two large eddies which straddled the Hudson Gorge giving rise to two distinct longshore currents. The first longshore current more or less hugged the coast and came to an abrupt end just south of Barnegat Inlet. Its minimum speed was from 3 to 4 miles per day, a figure that agrees very well with observed nontidal drifts in that area (Ketchum, Redfield and Ayers, 1951). The offshore current was less distinct with probable velocities from 4 to 5 miles per day. It was probably quite variable, being alternately swelled by longshore influx of saltier water and diminished by loss to seawards of the fresher water.

Further south, off Delaware Bay, rates of travel increased slightly, but these rates were uncertain because of the few local recoveries in the area. Practically all of the bottles, whether released or recovered in this area, drifted for considerable distance. The released bottles either were not heard from or stranded near Cape Hatteras. The recoveries were from the offshore New York area and the initial stations near Block Island. In contrast to the New York area, the surface circulation in this vicinity appeared to be relatively simple, although there were few recoveries to support this view. The longshore current apparently split again just north of Cape May, the seaward portion skirting the comparatively small effluent from Delaware Bay and the landward branch taking an active part in the circulation about the mouth of the bay. The "well-mixed" effluent from Delaware Bay spread in a wide arc whose center was Cape Henlopen and whose radius was limited to 10 to 15 miles. The northern portion of the arc returned part of the effluent in the landward branch of the longshore current. Some of the effluent spread eastward for a short distance and then became merged with a fairly

well-defined longshore current. At Chincoteague Inlet there appeared to be some sort of rotary motion which marked a change in the southerly flowing current, for below the inlet the current became somewhat divergent and ill-defined. This transition also marked an increase in the speed of the current from 4 to 6 miles per day in the Delaware environment to 5 to 7 miles per day.

The surface drifts off Chesapeake Bay were more certain than those of the previous areas because of the higher percentage of recoveries. The minimum rates of travel increased considerably from 8 to as much as 20 miles per day. The southerly flowing current was affected by the Chesapeake Bay effluent as far as 40 miles east of Cape Henry where it tended to flow to the west perhaps compensatory to the eastward flowing effluent mixture. This compensatory effect was most pronounced near the mouth of the bay where an anticyclonic eddy apparently was responsible for bottles being carried into the bay itself and for driving some of the fresher water northeast of Cape Charles. South of the 37° parallel the current consisted of effluent water and coastal drift with a speed of 9 to 11 miles per day, the greater figure being more apparent offshore. At $36^{\circ}40'$ the current moved shorewards with a consequent speed-up of drift, possibly 12 to 15 miles per day. In an isolated instance, 22 miles per day was recorded. The accelerated drift appeared to be confined by a large cyclonic eddy. It is worth noting that the greatest number of bottles in the survey were collected along the stretch of beach just south of this eddy ($36^{\circ}00'$ to $36^{\circ}20'$).

At Oregon Inlet there was an eddy of cool, saline water which may have funnelled or directed the migration of several bottles into Pamlico Sound similar in action to the eddy further north. The longshore current here comprised residual effluent from Chesapeake Bay combined with coastal drift. The region about Cape Hatteras was very complex with wide ranges of salinity and temperature. No bottles released in this area were recovered in the immediate vicinity. At present, two bottles have been heard from: one, released at a sea buoy just north of Cape Hatteras, drifted to Bermuda in 50 days; the other, released in the Gulf Stream, reached Rhode Island in 72 days. This last bottle suggests a great eddy in which the Gulf Stream is a part, for it was repeated in another instance where a bottle set adrift near Chincoteague Inlet was recovered at Martha's Vineyard 96 days later.

CONCLUSION

To reconstruct the surface coastal circulation in detail from either the surface salinity and temperature data or the drift bottle recoveries alone leaves much to be desired. This is also true, but less so, when the two types of data are combined. In its general aspects the analysis is no doubt convincing, but, as more and more details are deduced the analysis becomes less authentic. In this sense, the pattern of circulation as described here is assumed to be true. There are strong indications that the surface drift was more or less along lines of equal density. However, final estimates and descriptions of the coastal circulation for time of survey must wait for complete examination of the subsurface data.

In spite of the limitations, the surface data were well-adapted for describing the surface circulation. The detailed patterns which were developed from the drift bottle recoveries and the salinity-temperature data show that the coastal drift may be made up of several distinct currents or eddies with branches and offshoots merging or breaking away from the general drift. In particular, the influence of each fresh water contributor to the coastal circulation appears to have an appreciable effect upon the current pattern. Ketchum, Redfield, and Ayers (1951) found that off the New York area changing distribution patterns were to be expected when the river flow was small and that a well-defined pattern was developed when the river flow was great. Thus, the assumption of a steady state was ephemeral depending on the conditions. In this respect, the coastal circulation within the 30-fathom curve might be expected to be sensitive to seasonal and other changes. Consequently, the permanence of the detailed pattern is doubtful and further investigation is needed to determine the basic features of the coastal drift.

REFERENCES

Bigelow, H. B., 1927:

Physical oceanography of the Gulf of Maine. Bull. Bur. Fish. 40, 511-1027.

_____, 1933:

Studies of the waters on the continental shelf, Cape Cod to Chesapeake Bay: I, The cycle of temperature. Pap. Phys. Oceanog. and Meteorol., II, (4), 135 pp.

Bigelow, H. B. and Mary Sears, 1935:

Studies of the waters on the continental shelf, Cape Cod to Chesapeake Bay: II, Salinity. Pap. Phys. Oceanog. and Meteorol., IV, (1), 94 pp.

Ketchum, B. H., A. C. Redfield and J. C. Ayers, 1951:

The oceanography of the New York Bight. Pap. Phys. Oceanog. and Meteorol., XII, (1), 46 pp.

Powers, C. F. and J. C. Ayers, 1951:

Drift bottle studies in the Newport Bight and New York Bight areas. Cornell University, Contract N6onr-264, Task 15, NR-083-033. Status Rept. 11 (Restricted).

Redfield, A. C. and L. A. Walford, 1951:

A study of the disposal of chemical waste at sea. Rept. of Comm. for Investig. of Waste Disposal, Pub. No. 201 Nat. Res. Council, 49 pp.

Webster, J. R. and R. J. Buller, 1950:

Drift bottle releases off New Jersey. U.S. Fish and Wildlife Service, Spec. Scient. Rept.: Fish No. 10.

APPENDIX

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W. °	Miles drifted	Velocity mi/day	Days Adrift	Miles Drifted	Vel. m/d
6/14/51	39 31	74 15	4676	1	41 16	71 02	184	5.0	37	230	6.2
5/27/51	40 52	72 23	4686	2	41 06	71 17	53	2.8	19	71	3.7
6/ 2/51	41 10	71 33	4693	2	41 06	71 17	13	0.5	25	15	0.6
6/ 6/51	41 10	71 33	4690	2	41 06	71 17	13	0.4	29	14	0.5
6/12/51	41 09	71 32	4692	2	41 06	71 17	13	0.4	35	14	0.4
6/12/51	40 02	74 03	4695	2	41 06	71 17	141	4.0	35	177	5.0
6/13/51	39 23	74 22	4697	2	41 06	71 17	177	4.9	36	216	6.0
6/14/51	39 31	74 16	4694	2	41 06	71 17	169	4.6	37	213	5.8
7/22/51	38 56	74 53	4691	2	41 06	71 17	217	2.9	75	240	3.2
5/30/51	40 40	73 02	4705	3	41 06	71 23	80	3.6	22	132	6.0
6/ 4/51	40 35	73 30	4700	3	41 06	71 23	97	3.6	27	125	4.6
6/ 6/51	40 37	73 23	4703	3	41 06	71 23	96	3.3	29	124	4.3
6/10/51	39 56	74 04	4702	3	41 06	71 23	142	4.3	33	169	5.1
6/13/51	39 19	74 30	4706	3	41 06	71 23	179	5.0	36	214	5.9
6/14/51	39 42	74 07	4698	3	41 06	71 23	151	4.1	37	189	5.1
6/15/51	40 04	74 02	4708	3	41 06	71 23	138	3.6	38	165	4.3
6/17/51	39 49	74 05	4701	3	41 06	71 23	148	3.7	40	182	4.5
6/17/51	40 42	72 55	4699	3	41 06	71 23	74	1.8	40	138	3.4
6/22/51	38 33	75 03	4713	4	40 59	71 48	211	4.7	45	227	5.0
6/28/51	39 01	74 46	4712	4	40 59	71 48	183	3.6	51	224	4.4
6/14/51	39 03	74 45	4727	5	40 39	71 56	164	4.4	37	201	5.4
6/24/51	37 52	75 20	4723	5	40 39	71 56	233	5.0	47	252	5.4
8/ 5/51	37 48	75 30	4731	5	40 39	71 56	243	2.7	89	256	2.9
6/17/51	38 19	75 05	4744	6	40 11	72 09	180	4.6	39	220	5.6
6/19/51	38 27	75 03	4742	6	40 11	72 09	170	4.2	41	200	4.9
7/20/51	37 54	75 19	4740	6	40 11	72 09	207	2.9	72	245	3.4
6/14/51	38 02	75 03	4179	7	40 22	72 39	186	5.2	36	215	6.0
6/22/51	38 31	75 03	4178	7	40 22	72 39	158	3.6	44	172	3.9
8/10/51	37 25	75 41	4175	7	40 22	72 39	232	2.5	93	268	2.8
8/27/51	38 11	75 09	4174	7	40 22	72 39	179	1.6	110	206	1.9
5/12/51	40 40	73 01	4185	8	40 34	73 12	12	4.0	3	12	4.0
5/12/51	40 40	73 01	4187	8	40 34	73 12	12	4.0	3	12	4.0
5/12/51	40 40	73 01	4188	8	40 34	73 12	12	4.0	3	12	4.0
5/12/51	40 40	73 01	4189	8	40 34	73 12	12	4.0	3	12	4.0

RECOVERY			RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles Drifted	Vel. m/d	
5/12/51	40 40	73 01	4190	8	40 34	73 12	12	4.0	3	12	4.0	
5/12/51	40 40	73 02	4191	8	40 34	73 12	10	3.3	3	10.5	3.5	
5/12/51	40 40	73 02	4192	8	40 34	73 12	10	3.3	3	10.5	3.5	
5/12/51	40 40	73 02	4193	8	40 34	73 12	10	3.3	3	10.5	3.5	
5/12/51	40 40	73 02	4195	8	40 34	73 12	10	3.3	3	10.5	3.5	
5/12/51	40 40	73 02	4196	8	40 34	73 12	10	3.3	3	10.5	3.5	
5/20/51	40 05	74 02	4206	9	40 27	73 13	44	4.0	11	53	4.8	
5/21/51	40 03	74 02	4203	9	40 27	73 13	45	3.7	12	59	4.9	
5/21/51	40 08	74 01	4207	9	40 27	73 13	42	3.5	12	61	5.1	
5/21/51	39 57	74 04	4208	9	40 27	73 13	48	4.0	12	62	5.2	
5/22/51	40 05	74 02	4204	9	40 27	73 13	44	3.4	13	55	4.2	
5/24/51	40 09	74 01	4197	9	40 27	73 13	41	2.7	15	71	4.7	
6/ 9/51	40 37	73 18	4200	9	40 27	73 13	12	0.4	31	14	0.4	
6/21/51	38 59	74 48	4202	9	40 27	73 13	116	2.5	43	132	3.1	
6/23/51	39 04	74 44	4198	9	40 27	73 13	109	2.4	45	131	2.9	
5/21/51	40 06	74 02	4209	10	40 26	73 31	31	2.6	12	38	3.2	
5/21/51	40 05	74 02	4211	10	40 26	73 31	32	2.7	12	43	3.6	
5/21/51	40 07	74 01	4213	10	40 26	73 31	29	2.4	12	36	3.0	
5/21/51	40 02	74 03	4214	10	40 26	73 31	35	2.9	12	49	4.1	
5/21/51	40 00	74 02	4219	10	40 26	73 31	35	2.9	12	49	4.1	
5/22/51	40 06	74 02	4217	10	40 26	73 31	31	2.4	13	41	3.2	
5/22/51	39 55	74 04	4218	10	40 26	73 31	41	3.6	13	57	4.4	
5/24/51	40 05	74 04	4220	10	40 26	73 31	32	2.1	15	48	3.2	
7/ 9/51	40 01	74 03	4210	10	40 26	73 31	34	0.5	61	55	0.9	
5/19/51	40 10	75 00	4221	11	40 29	73 50	20	2.0	10	21	2.1	
5/19/51	40 09	74 01	4222	11	40 29	73 50	20	2.0	10	22.5	2.2	
5/19/51	40 09	74 01	4225	11	40 29	73 50	20	2.0	10	22.5	2.2	
5/19/51	40 02	74 02	4227	11	40 29	73 50	28	2.8	10	41	4.1	
5/19/51	40 11	74 00	4229	11	40 29	73 50	20	2.0	10	21	2.1	
5/19/51	39 57	74 04	4230	11	40 29	73 50	33	3.3	10	47	4.7	
5/19/51	39 58	74 03	4232	11	40 29	73 50	32	3.2	10	48	4.8	
5/20/51	40 08	74 01	4224	11	40 29	73 50	22	2.0	11	45	4.1	
5/20/51	40 29	74 02	4228	11	40 29	73 50	23	2.1	11	48	4.3	
5/18/51	40 04	74 02	4239	12	40 27	73 54	23	2.6	9	43	4.8	

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N ° ' "	Long. W ° ' "	Bottle	Sta.	Lat. N ° ' "	Long. W ° ' "	Miles drifted	Velocity mi/day	Days Adrift	Miles Drifted	Vel. m/d
5/18/51	40 02	74 03	4238	12	40 27	73 54	26	2.9	9	47	5.2
5/18/51	40 04	74 02	4243	12	40 27	73 54	22	2.4	9	42	4.7
5/19/51	40 38	74 07	4237	12	40 27	73 54	16	1.6	10	16.5	1.6
5/19/51	40 06	74 02	4241	12	40 27	73 54	21	2.1	10	53	5.3
5/27/51	39 53	74 04	4235	12	40 27	73 54	35	1.9	18	71	3.9
5/22/51	40 05	74 02	4242	12	40 27	73 54	21	1.6	13	47	3.6
5/18/51	39 56	74 04	5414	13	40 20	73 52	27	3.0	9	27	3.0
5/18/51	39 55	74 04	5415	13	40 20	73 52	27	3.0	9	28	3.1
5/18/51	39 56	74 04	5418	13	40 20	73 52	27	3.0	9	28	3.1
5/18/51	39 56	74 04	5419	13	40 20	73 52	27	3.0	9	27	3.0
5/18/51	39 56	74 04	5422	13	40 20	73 52	27	3.0	9	27	3.0
5/20/51	39 46	74 05	5420	13	40 20	73 52	35	3.2	11	43	3.9
5/24/51	39 55	74 04	5424	13	40 20	73 52	27	1.8	15	58	3.9
5/30/51	39 53	74 04	5421	13	40 20	73 52	28	1.3	21	67	3.2
6/ 3/51	39 59	74 03	5416	13	40 20	73 52	23	0.9	25	48	1.9
5/20/51	39 56	74 04	5401	14	40 20	73 34	33	3.0	11	42	3.8
5/20/51	39 46	74 05	5406	14	40 20	73 34	42	3.8	11	60	5.4
5/22/51	39 24	74 22	5411	14	40 20	73 34	67	5.1	13	84	6.4
5/30/51	39 36	74 20	5409	14	40 20	73 34	53	2.5	21	87	4.1
6/ 9/51	39 21	74 25	5396	15	40 20	73 14	83	2.7	31	108	3.5
6/ 9/51	39 14	74 36	5391	15	40 20	73 14	93	3.0	31	115	3.7
6/11/51	39 11	74 39	5393	15	40 20	73 14	96	2.9	33	121	3.6
6/12/51	38 19	75 05	5392	15	40 20	73 14	150	4.4	34	190	5.6
6/12/51	39 16	74 33	5400	15	40 20	73 14	89	2.6	34	117	3.4
6/18/51	38 27	75 03	5395	15	40 20	73 14	143	3.6	40	187	4.7
6/22/51	38 09	75 10	5398	15	40 20	73 14	160	3.6	44	176	4.0
6/27/51	38 20	75 05	5399	15	40 20	73 14	149	3.0	49	165	3.4
6/30/51	38 29	75 03	5431	16	40 05	73 14	129	2.5	52	200	3.8
6/26/51	37 31	75 37	5430	16	40 05	73 14	196	4.0	48	246	5.1
6/20/51	35 55	75 36	5446	17	40 05	73 27	271	6.5	42	342	8.1
6/20/51	36 01	75 39	5448	17	40 05	73 27	267	6.3	42	356	8.5
6/24/51	37 07	75 58	5441	17	40 05	73 27	218	4.7	46	302	6.6
7/22/51	36 10	75 44	5444	17	40 05	73 27	259	3.5	74	300	4.1
5/18/51	40 05	74 02	5453	18	40 05	73 39	17	1.9	9	38	4.2

RECOVERY			RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles Drifted	Vel. m/d	
5/19/51	40 02	74 03	5449	18	40 05	73 39	18	1.8	10	41	4.1	
5/19/51	40 05	74 02	5450	18	40 05	73 39	17	1.7	10	40	4.0	
5/19/51	39 59	74 03	5451	18	40 05	73 39	18	1.8	10	45	4.5	
5/19/51	39 59	74 03	5454	18	40 05	73 39	19	1.9	10	45	4.5	
5/19/51	40 02	74 02	5455	18	40 05	73 39	18	1.8	10	41	4.1	
5/19/51	39 57	74 04	5456	18	40 05	73 39	20	2.0	10	46	4.6	
5/19/51	39 59	74 03	5458	18	40 05	73 39	18	1.8	10	45	4.5	
5/19/51	40 02	74 02	5459	18	40 05	73 39	17	1.7	10	42	4.2	
5/19/51	39 59	74 03	5460	18	40 05	73 39	19	1.9	10	45	4.5	
5/20/51	39 55	74 04	5452	18	40 05	73 39	21	1.9	11	47	4.3	
5/20/51	39 56	74 04	4607	19	40 03	73 46	15	1.5	10	48	4.8	
5/20/51	39 56	74 04	4613	19	40 03	73 46	15	1.5	10	48	4.8	
5/26/51	39 52	74 05	4602	19	40 03	73 46	19	1.2	16	60	3.7	
5/26/51	39 56	74 04	4605	19	40 03	73 46	16	1.0	16	69	4.3	
5/26/51	39 54	74 04	4606	19	40 03	73 46	18	1.1	16	72	4.5	
5/26/51	39 56	74 04	4609	19	40 03	73 46	16	1.0	16	69	4.3	
5/26/51	39 54	74 04	4610	19	40 03	73 46	18	1.1	16	72	4.5	
5/26/51	39 54	74 04	4612	19	40 03	73 46	18	1.1	16	72	4.5	
5/26/51	39 54	74 04	4612	19	40 03	73 46	18	1.1	16	72	4.5	
5/27/51	39 54	74 04	4611	19	40 03	73 46	17	1.0	17	72	4.2	
5/30/51	39 55	74 04	4604	19	40 03	73 46	16	0.8	20	81	4.0	
5/30/51	39 54	74 04	4603	19	40 03	73 46	17	0.8	20	72	4.5	
6/14/51	37 51	75 27	4617	20	39 53	73 41	148	4.2	35	160	4.6	
6/23/51	37 08	75 58	4618	20	39 53	73 41	202	4.6	44	247	5.6	
6/23/51	37 57	75 17	4621	20	39 53	73 41	139	3.1	44	149	3.4	
8/ 3/51	39 14	74 37	4622	20	39 53	73 41	59	0.7	85	61	0.7	
7/28/51	37 09	75 51	4616	20	39 53	73 41	193	2.5	79	277	3.5	
8/ 4/51	37 18	75 45	4614	20	39 53	73 41	184	2.2	86	214	2.5	
6/14/51	37 51	75 27	4639	22	39 42	73 35	141	4.0	35	157	4.5	
6/17/51	37 53	75 20	4644	22	39 42	73 35	139	3.7	38	150	4.0	
7/22/51	37 40	75 35	4641	22	39 42	73 35	156	2.1	73	170	2.3	
8/ 5/51	37 54	75 19	4645	22	39 42	73 35	138	1.6	87	143	1.6	
8/ 8/51	37 10	75 59	4647	22	39 42	73 35	199	2.2	90	283	3.2	
5/23/51	39 09	74 41	4656	23	39 43	73 47	57	4.4	13	56	4.3	
5/25/51	39 09	74 41	4659	23	39 43	73 47	54	3.6	15	56	3.7	

RECOVERY			RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d	
5/27/51	39 09	74 41	4657	23	39 43	73 47	57	3.4	17	56	3.3	
6/ 4/51	39 10	74 40	4654	23	39 43	73 47	54	2.2	25	56	2.2	
6/14/51	37 51	75 27	4653	23	39 43	73 47	137	3.9	35	150	4.3	
6/17/51	38 41	75 24	4660	23	39 43	73 47	86	2.3	38	82	2.2	
7/22/51	38 54	75 32	4658	23	39 43	73 47	147	2.0	73	158	2.2	
5/11/51	39 44	74 06	4662	24	39 45	74 02	3	3.0	1	3.5	3.5	
5/11/51	39 42	75 07	4663	24	39 45	74 02	5	5.0	1	5	5.0	
5/11/51	39 45	74 06	4665	24	39 45	74 02	3	3.0	1	3.5	3.5	
5/11/51	39 44	74 06	4668	24	39 45	74 02	3	3.0	1	3.5	3.5	
5/12/51	39 44	74 06	4671	24	39 45	74 02	3	1.5	2	3.5	1.8	
5/13/51	39 45	74 06	4664	24	39 45	74 02	3	1.0	3	3.5	1.2	
5/14/51	39 43	74 07	4666	24	39 45	74 02	5	1.2	4	4.2	1.0	
5/14/51	39 45	74 02	4669	24	39 45	74 02	3	0.8	4	3.5	0.9	
5/22/51	39 41	74 08	4672	24	39 45	74 02	6	0.5	12	6	0.5	
6/19/51	39 19	74 30	4673	24	39 45	74 02	35	0.9	40	51	1.3	
7/31/51	37 55	75 19	4828	25	39 34	73 49	124	1.5	82	138	1.7	
6/22/51	37 08	75 58	4846	29	39 26	74 02	170	4.0	43	224	5.2	
6/24/51	37 07	75 58	4852	29	39 26	74 02	173	3.8	45	222	4.9	
7/ 1/51	37 07	75 58	4843	29	39 26	74 02	170	3.3	52	255	4.9	
5/13/51	39 32	74 15	4850	29	39 27	74 11	6	2.0	3	7	2.3	
6/11/51	39 32	74 17	4856	30	39 27	74 11	8	0.2	32	8	0.2	
6/24/51	39 34	74 20	4864	30	39 27	74 11	12	0.3	45	11	0.2	
7/ 4/51	39 35	74 20	4855	30	39 27	74 11	12	0.2	55	11	0.2	
5/11/51	39 25	74 20	4868	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4869	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4871	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4872	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4873	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4874	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4875	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/11/51	39 25	74 20	4876	31	39 26	74 12	7	7.0	1	4.7	4.7	
5/12/51	39 25	74 20	4867	31	39 26	74 12	7	3.5	2	4.7	2.4	
5/14/51	39 24	74 22	4866	31	39 26	74 12	8	2.0	4	6	1.5	

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N o ' "	Long. W o ' "	Bottle	Sta.	Lat. N o ' "	Long. W o ' "	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d
5/17/51	39 25	74 20	4870	31	39 26	74 12	7	1.0	7	4.7	0.7
7/20/51	36 10	75 39	4252	33	39 02	73 42	203	2.9	71	260	3.7
5/19/51	38 41	75 04	5245	39	39 07	74 34	35	3.9	9	36	4.0
5/19/51	38 42	75 04	5248	39	39 07	74 34	35	3.9	9	36	4.0
5/19/51	38 41	75 04	5254	39	39 07	74 34	35	3.9	9	36	4.0
5/19/51	38 42	75 04	5256	39	39 07	74 34	35	3.9	9	36	4.0
5/20/51	38 42	75 04	5246	39	39 07	74 34	35	3.5	10	36	3.6
5/21/51	38 46	75 07	5250	39	39 07	74 34	32	2.9	11	32	2.9
5/21/51	38 30	75 03	5252	39	39 07	74 34	43	3.9	11	48	4.4
5/22/51	38 46	75 04	5253	39	39 07	74 34	33	2.8	12	33	2.8
6/20/51	35 56	75 37	5257	40	39 01	74 28	193	4.7	41	250	6.1
6/21/51	35 14	75 31	5259	40	39 01	74 28	234	5.6	42	284	6.8
6/22/51	35 34	75 27	5263	40	39 01	74 28	214	5.0	43	263	6.1
6/24/51	35 06	75 56	5268	40	39 01	74 28	248	5.5	45	308	6.8
8/ 8/51	35 45	75 30	5260	40	39 01	74 28	205	2.3	90	251	2.8
6/21/51	35 14	75 31	5279	41	38 54	74 22	227	5.4	42	275	6.5
8/ 7/51	35 30	75 28	5273	41	38 54	74 22	212	2.4	89	258	2.9
6/19/51	35 23	75 29	4798	43	38 58	74 45	220	5.6	39	255	6.5
6/21/51	35 16	75 30	4973	46	38 47	75 01	214	5.2	41	248	6.0
6/ 6/51	37 34	75 37	4974	47	38 47	74 54	80	3.1	26	90	3.4
6/19/51	35 16	75 30	4978	47	38 47	74 54	214	5.5	39	241	6.2
6/18/51	35 18	75 30	4987	48	38 47	74 46	212	5.6	38	242	6.4
6/19/51	35 15	75 31	4993	48	38 47	74 46	216	5.5	39	246	6.3
6/28/51	35 21	75 29	4989	48	38 47	74 46	210	4.4	48	244	5.1
8/ 3/51	35 13	75 37	4995	48	38 47	74 46	219	2.6	84	258	3.1
6/ 6/51	37 34	75 37	5603	51	38 42	74 59	74	2.8	26	78	3.0
6/11/51	37 18	75 46	5607	51	38 42	74 59	93	3.0	31	101	3.3
			5608	51							
5/21/51	36 49	75 58	4944	72	37 50	75 12	66	7.3	9	75	8.3
5/21/51	35 54	75 35	4954	73	37 48	75 22	115	12.8	9	145	16.1
5/22/51	35 55	75 36	4958	73	37 48	75 22	114	11.4	10	140	14.0
5/23/51	35 57	75 37	4957	73	37 48	75 22	112	10.1	11	135	12.2
5/24/51	36 50	75 58	4950	73	37 48	75 22	66	5.5	12	80	6.7
			4952								

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d
5/25/51	36 24	75 49	4961	73	37 48	75 22	88	6.8	13	104	8.0
8/ 6/51	35 46	75 31	4955	73	37 48	75 22	123	1.5	86	146	1.7
5/19/51	36 29	75 51	4510	78	37 32	75 19	67	9.6	7	80	11.4
5/21/51	35 56	75 36	4513	78	37 32	75 19	96	10.7	9	118	13.1
5/21/51	35 53	75 35	4519	78	37 32	75 19	100	11.1	9	133	14.8
5/23/51	35 45	75 30	4509	78	37 32	75 19	106	9.6	11	142	12.9
6/15/51	35 49	75 33	4515	78	37 32	75 19	104	3.1	34	131	3.9
6/15/51	35 35	75 27	4516	78	37 32	75 19	117	3.4	34	141	4.2
6/29/51	35 47	75 32	4511	78	37 32	75 19	106	2.2	48	130	2.7
5/19/51	36 41	75 55	4527	79	37 31	75 26	56	8.0	7	69	9.9
5/20/51	36 41	75 55	4528	79	37 31	75 26	55	6.9	8	68	8.5
5/20/51	37 17	75 46	4531	79	37 31	75 26	22	2.8	8	24	3.0
5/24/51	35 40	75 28	4529	79	37 31	75 26	110	9.2	12	141	11.8
7/ 7/51	36 39	75 54	4532	79	37 31	75 26	58	1.0	56	69	1.2
8/ 5/51	37 09	75 50	4522	79	37 31	75 26	31	0.4	85	—	—
5/19/51	36 34	75 56	5101	80	37 29	75 29	49	7.0	7	66	9.4
5/19/51	36 46	75 57	5103	80	37 29	75 29	47	6.7	7	67	9.5
5/19/51	36 44	75 56	5105	80	37 29	75 29	49	7.0	7	69	9.8
5/19/51	36 47	75 57	5106	80	37 29	75 29	47	6.7	7	67	9.5
5/19/51	36 41	75 55	5107	80	37 29	75 29	52	7.4	7	66	9.4
5/19/51	36 42	75 55	5108	80	37 29	75 29	51	7.2	7	66	9.4
5/19/51	36 44	75 56	5109	80	37 29	75 29	49	7.0	7	69	9.8
5/19/51	36 43	75 56	5110	80	37 29	75 29	50	7.1	7	66	9.4
5/19/51	36 43	75 56	5112	80	37 29	75 29	51	7.4	7	66	9.4
5/21/51	36 45	75 57	5111	80	37 29	75 29	49	5.4	9	68	7.6
6/16/51	36 49	75 58	5102	80	37 29	75 29	47	1.3	35	61	1.7
7/ 7/51	36 39	75 54	5104	80	37 29	75 29	56	1.0	56	67	1.2
5/24/51	35 13	75 31	5116	81	37 19	74 57	127	11.5	11	158	14.3
5/19/51	36 09	75 44	5149	84	37 03	75 14	58	9.7	6	83	13.7
5/19/51	36 11	75 45	5150	84	37 03	75 14	58	9.7	6	79	13.2
5/19/51	36 10	75 45	5152	84	37 03	75 14	58	9.7	6	79	13.2
5/19/51	36 14	75 46	5153	84	37 03	75 14	56	9.3	6	75	12.5
5/19/51	36 10	75 45	5154	84	37 03	75 14	58	9.7	6	79	13.2
5/19/51	36 14	75 46	5155	84	37 03	75 14	56	9.3	6	75	13.5

RECOVERY			RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d	
5/19/51	36 13	75 46	5158	84	37 03	75 14	56	9.3	6	77	12.8	
5/19/51	36 13	75 46	5159	84	37 03	75 14	56	9.4	6	77	12.8	
5/19/51	36 11	75 45	5160	84	37 03	75 14	58	9.7	6	80	13.3	
5/20/51	36 13	75 45	5151	84	37 03	75 14	56	8.0	7	79	11.3	
5/19/51	36 11	75 45	5161	85	37 02	75 25	55	9.2	6	73	12.2	
5/19/51	36 04	75 41	5165	85	37 02	75 25	60	10.0	6	79	13.0	
5/19/51	36 11	75 45	5167	85	37 02	75 25	55	9.2	6	71	11.8	
5/19/51	36 10	75 44	5168	85	37 02	75 25	55	9.2	6	72	12.0	
5/19/51	36 10	75 45	5172	85	37 02	75 25	55	9.2	6	72	12.0	
5/20/51	36 04	75 41	5169	85	37 02	75 25	60	8.6	7	80	11.5	
5/21/51	36 09	75 44	5162	85	37 02	75 25	57	7.1	8	73	9.1	
5/24/51	36 14	75 46	5166	85	37 02	75 25	53	5.3	10	69	6.9	
5/26/51	36 10	75 44	5171	85	37 02	75 25	54	4.2	13	72	5.5	
6/ 3/51	36 03	75 40	5170	85	37 02	75 25	61	2.9	21	75	3.6	
5/19/51	35 46	75 31	5461	86	37 02	75 31	76	12.7	6	100	16.7	
5/19/51	35 56	75 36	5467	86	37 02	75 31	67	11.2	6	84	14.0	
5/19/51	36 13	75 46	5469	86	37 02	75 31	51	8.5	6	65	10.8	
5/19/51	35 52	75 34	5470	86	37 02	75 31	70	11.6	6	94	15.8	
5/20/51	35 57	75 37	5462	86	37 02	75 31	65	9.3	7	80	11.4	
5/17/51	36 41	75 55	5481	87	37 06	75 41	26	6.5	4	39	9.8	
5/17/51	36 41	75 55	5482	87	37 06	75 41	27	6.7	4	39	9.8	
5/18/51	36 44	75 56	5475	87	37 06	75 41	26	5.2	5	35	7.0	
5/18/51	36 42	75 55	5478	87	37 06	75 41	26	5.2	5	35	7.0	
5/18/51	36 43	75 56	5479	87	37 06	75 41	26	5.2	5	34	6.8	
5/18/51	36 41	75 55	5484	87	37 06	75 41	26	5.2	5	39	7.8	
5/19/51	36 01	75 39	5474	87	37 06	75 41	65	10.8	6	77	12.8	
5/19/51	36 41	75 55	5476	87	37 06	75 41	27	4.5	6	39	6.5	
5/19/51	36 41	75 55	5483	87	37 06	75 41	27	4.5	6	39	6.5	
5/22/51	36 48	75 57	5473	87	37 06	75 41	23	2.6	9	33	3.7	
6/16/51	36 49	75 58	5477	87	37 06	75 41	23	0.7	34	59	1.7	
5/19/51	36 55	76 07	5489	88	37 03	75 48	17	2.8	6	18	3.0	
5/19/51	36 41	75 55	5495	88	37 03	75 48	23	3.8	6	31	5.2	
5/20/51	36 55	76 00	5485	88	37 03	75 48	12	1.7	7	18	2.6	
5/24/51	35 15	75 31	5496	88	37 03	75 48	109	9.9	11	129	11.7	

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d
5/26/51	36 55	76 00	5494	88	37 03	75 48	12	0.9	13	18	2.6
7/1/51	36 38	75 53	5492	88	37 03	75 48	25	0.5	55	65	1.2
5/16/51	36 40	75 54	5507	89	36 59	75 54	18	6.0	3	28	9.3
5/16/51	36 41	75 55	5508	89	36 59	75 54	18	6.0	3	27	9.0
5/26/51	36 41	75 55	5500	89	36 59	75 54	18	1.4	13	54	4.2
7/14/51	36 36	75 52	5506	89	36 59	75 54	23	0.4	62	63	1.0
5/14/51	36 47	75 57	5509	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5510	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5511	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5512	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5513	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5514	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5515	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5516	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5517	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5518	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5519	90	36 55	75 58	7	7.0	1	11	11.0
5/14/51	36 47	75 57	5520	90	36 55	75 58	7	7.0	1	11	11.0
5/18/51	36 00	75 39	5424	91	36 58	75 41	57	11.4	5	79	15.8
5/18/51	36 00	75 39	5427	91	36 58	75 41	57	11.4	5	79	15.8
5/19/51	36 07	75 43	5526	91	36 58	75 41	51	8.5	6	66	11.0
5/19/51	35 56	75 36	5532	91	36 58	75 41	62	10.3	6	78	13.0
5/20/51	36 03	75 40	5521	91	36 58	75 41	55	7.9	7	74	10.6
5/20/51	36 03	75 40	5525	91	36 58	75 41	55	7.9	7	74	10.6
6/10/51	36 12	75 45	5522	91	36 58	75 41	47	1.7	28	65	2.2
5/16/51	36 05	75 42	5523	91	36 58	75 41	54	18.0	3	68	22.6
5/17/51	36 03	75 40	5767	93	36 51	75 18	52	13.0	4	60	15.0
5/19/51	36 00	75 39	5761	93	36 51	75 18	53	8.8	6	67	11.1
5/19/51	36 01	75 39	5762	93	36 51	75 18	56	9.3	6	65	10.8
5/19/51	36 01	75 39	5764	93	36 51	75 18	54	9.0	6	65	10.8
5/19/51	36 03	75 41	5766	93	36 51	75 18	51	8.5	6	64	10.8
5/20/51	35 57	75 37	5758	93	36 51	75 18	53	7.6	7	67	9.6
5/20/51	35 57	75 37	5760	93	36 51	75 18	53	7.6	7	67	9.6
5/20/51	35 57	75 37	5765	93	36 51	75 18	53	7.6	7	67	9.6

RECOVERY				RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N o	Long. W o	Bottle	Sta.	Lat. N o	Long. W o	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d		
6/11/51	36 03	75 41	5759	93	36 51	75 18	52	1.8	29	60	2.1		
5/18/51	35 53	75 34	5772	94	36 51	75 25	58	11.6	5	66	13.2		
5/18/51	36 05	75 42	5779	94	36 51	75 25	49	9.8	5	55	11.0		
5/19/51	35 57	75 37	5770	94	36 51	75 25	55	9.2	6	71	10.1		
5/19/51	36 00	75 39	5773	94	36 51	75 25	52	8.7	6	59	9.8		
5/19/51	36 04	75 41	5776	94	36 51	75 25	50	8.3	6	64	10.7		
5/19/51	36 04	75 41	5777	94	36 51	75 25	50	8.3	6	64	10.7		
5/19/51	35 56	75 36	5780	94	36 51	75 25	55	9.2	6	63	10.5		
5/20/51	35 57	75 37	5771	94	36 51	75 25	55	7.9	7	71	10.1		
5/20/51	35 57	75 37	5774	94	36 51	75 25	55	7.9	7	61	8.7		
5/26/51	35 46	75 32	5778	94	36 51	75 25	64	4.9	13	127	8.7		
5/17/51	36 22	75 49	5781	95	36 51	75 25	29	7.2	4	33	9.8		
5/17/51	36 22	75 49	5782	95	36 51	75 25	29	7.2	4	33	8.2		
5/17/51	36 22	75 49	5783	95	36 51	75 25	29	7.2	4	33	8.2		
5/17/51	36 22	75 49	5786	95	36 51	75 25	29	7.2	4	33	8.2		
5/17/51	36 22	75 49	5787	95	36 51	75 25	29	7.2	4	33	8.2		
5/17/51	36 22	75 49	5789	95	36 51	75 25	29	7.2	4	33	8.2		
5/17/51	36 25	75 50	5790	95	36 51	75 39	23	7.0	4	29	7.3		
5/17/51	36 25	75 49	5791	95	36 51	75 39	28	7.0	4	30	7.5		
5/17/51	36 26	75 50	5792	95	36 51	75 39	26	6.5	4	28	7.0		
5/19/51	36 20	75 48	5788	95	36 51	75 39	31	5.2	6	34	5.7		
5/24/51	36 13	75 46	5784	95	36 51	75 39	39	3.5	11	41	3.7		
5/16/51	36 16	75 47	5804	96	36 50	75 47	34	11.3	3	37	12.4		
5/17/51	36 26	75 50	5796	96	36 50	75 47	25	6.2	4	26	6.5		
5/17/51	36 26	75 50	5797	96	36 50	75 47	25	6.2	4	26	6.5		
5/17/51	36 26	75 50	5798	96	36 50	75 47	25	6.2	4	26	6.5		
5/17/51	36 21	75 49	5801	96	36 50	75 47	30	7.5	4	37	9.3		
5/17/51	36 20	75 49	5802	96	36 50	75 47	30	7.5	4	37	9.3		
5/19/51	36 20	75 48	5793	96	36 50	75 47	30	5.0	6	38	6.3		
5/19/51	36 17	75 47	5794	96	36 50	75 47	33	5.5	6	35	5.8		
6/ 3/51	36 22	75 49	5800	96	36 50	75 47	28	1.3	21	30	1.4		
5/14/51	36 48	75 57	5805	97	36 50	75 53	5	5.0	1	4.5	4.5		
5/14/51	36 48	75 57	5806	97	36 50	75 53	5	5.0	1	4.5	4.5		
5/14/51	36 48	75 57	5807	97	36 50	75 53	5	5.0	1	4.5	4.5		
5/14/51	36 48	75 57	5808	97	36 50	75 53	5	5.0	1	4.5	4.5		

RECOVERY			RELEASE			MINIMUM DRIFT			ADJUSTED MIN. DRIFT		
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d
5/14/51	36 48	75 57	5809	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5810	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5811	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5812	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5813	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5814	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5815	97	36 50	75 53	5	5.0	1	4.5	4.5
5/14/51	36 48	75 57	5816	97	36 50	75 53	5	5.0	1	4.5	4.5
5/18/51	36 00	75 39	4426	98	36 40	75 13	45	11.2	4	57	14.2
5/18/51	36 00	75 39	4428	98	36 40	75 13	45	11.2	4	57	14.2
5/18/51	36 00	75 39	4435	98	36 40	75 13	45	11.2	4	57	14.2
5/19/51	36 00	75 39	4429	98	36 40	75 13	46	9.2	5	57	11.4
5/19/51	36 04	75 41	4430	98	36 40	75 13	44	8.8	5	56	11.2
5/19/51	36 00	75 39	4431	98	36 40	75 13	46	9.2	5	57	11.4
5/19/51	36 01	75 39	4433	98	36 40	75 13	46	9.2	5	58	11.6
5/19/51	36 00	75 39	4434	98	36 40	75 13	45	9.0	5	57	11.4
5/19/51	36 01	75 39	4436	98	36 40	75 13	46	9.2	5	58	11.6
5/20/51	36 03	75 40	4432	98	36 40	75 13	44	6.3	7	57	9.5
5/21/51	36 02	75 40	4427	98	36 40	75 13	46	6.6	7	57	8.1
5/18/51	36 03	75 41	4423	98A	36 45	75 12	49	12.2	4	60	15.0
5/18/51	36 01	75 39	4424	98A	36 45	75 12	51	12.7	4	61	15.2
5/19/51	35 55	75 36	4414	98A	36 45	75 12	55	10.2	5	67	13.4
5/19/51	35 55	75 36	4415	98A	36 45	75 12	54	10.8	5	66	13.2
5/19/51	35 56	75 36	4417	98A	36 45	75 12	52	10.4	5	65	13.0
5/19/51	36 00	75 38	4419	98A	36 45	75 12	50	10.0	5	60	12.0
5/20/51	35 55	75 36	4422	98A	36 45	75 12	55	9.2	6	67	11.2
5/27/51	35 48	75 32	4420	98A	36 45	75 12	58	4.5	13	125	9.6
6/14/51	35 46	75 31	4421	98A	36 45	75 12	61	2.0	31	122	3.9
5/17/51	35 57	75 37	4445	99	36 40	75 22	46	15.3	3	53	17.6
5/18/51	36 01	75 39	4437	99	36 40	75 22	42	10.5	4	49	12.2
5/18/51	36 00	75 39	4441	99	36 40	75 22	42	10.5	4	50	12.5
5/19/51	36 00	75 39	4439	99	36 40	75 22	43	8.6	5	51	10.2
5/19/51	36 00	75 38	4440	99	36 40	75 22	43	8.6	5	51	10.2
5/19/51	36 00	75 39	4442	99	36 40	75 22	42	8.4	5	50	10.0

RECOVERY			RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d	
5/20/51	36 03	75 40	4438	99	36 40	75 22	41	6.8	6	50	8.3	
6/ 7/51	35 48	75 32	4444	99	36 40	75 22	53	2.2	24	150	6.3	
6/27/51	35 49	75 39	4448	99	36 40	75 22	64	1.5	44	117	2.7	
5/17/51	35 56	75 36	4449	100	36 40	75 27	45	15.0	3	49	16.3	
5/17/51	35 56	75 36	4450	100	36 40	75 27	46	15.3	3	49	16.3	
5/17/51	35 57	75 37	4452	100	36 40	75 27	45	15.0	3	50	16.7	
5/17/51	35 56	75 36	4454	100	36 40	75 27	44	14.7	3	51	17.0	
5/17/51	35 57	75 37	4455	100	36 40	75 27	43	14.3	3	48	16.0	
5/17/51	35 58	75 38	4457	100	36 40	75 27	43	14.3	3	47	15.6	
5/19/51	36 01	75 39	4453	100	36 40	75 27	41	8.2	5	45	9.0	
5/22/51	35 55	75 36	4458	100	36 40	75 27	46	5.8	8	102	12.7	
5/31/51	35 21	75 30	4456	100	36 40	75 27	81	4.8	17	168	9.9	
5/17/51	36 09	75 44	6033	101	36 40	75 39	31	10.3	3	32	10.7	
5/17/51	36 11	75 45	6034	101	36 40	75 39	31	10.3	3	31	10.3	
5/17/51	36 01	75 39	6036	101	36 40	75 39	39	13.0	3	41	13.7	
5/17/51	36 10	75 44	6037	101	36 40	75 39	31	10.3	3	32	10.7	
5/17/51	36 10	75 44	6038	101	36 40	75 39	31	10.3	3	32	10.7	
5/17/51	36 10	75 44	6039	101	36 40	75 39	31	10.3	3	32	10.7	
5/17/51	36 10	75 44	6040	101	36 40	75 39	31	10.3	3	32	10.7	
5/17/51	36 10	75 44	6044	101	36 40	75 39	31	10.3	3	31	10.3	
5/19/51	36 00	75 38	6043	101	36 40	75 39	40	8.0	5	42	8.4	
5/24/51	36 03	75 40	6035	101	36 40	75 39	37	3.7	10	40	4.0	
7/12/51	36 10	75 39	6042	101	36 40	75 39	31	0.5	0.5	32	0.5	
5/16/51	36 11	75 45	4401	102	36 40	75 46	29	9.7	3	30	10.0	
5/16/51	36 08	75 43	4402	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 08	75 43	4403	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 08	75 43	4404	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 08	75 43	4407	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 08	75 43	4409	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 08	75 43	4410	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 08	75 43	4411	102	36 40	75 46	32	10.1	3	33	11.0	
5/16/51	36 14	75 46	4405	102	36 40	75 46	26	8.7	3	27.5	9.1	
5/16/51	36 11	75 45	4408	102	36 40	75 46	28	9.3	3	30	10.0	
5/16/51	36 07	75 43	4406	102	36 40	75 46	32	10.1	3	3.3	11.0	

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N o	Long. W o	Bottle	Sta.	Lat. N o	Long. W o	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d
5/16/51	36 12	75 45	4412	102	36 40	75 46	28	9.3	3	30	10.0
5/16/51	36 12	75 45	4418	102	36 40	75 46	28	9.3	3	30	10.0
5/16/51	36 09	75 44	4389	103	36 40	75 51	32	10.1	3	37	12.3
5/16/51	36 13	75 46	4390	103	36 40	75 51	28	9.3	3	29	9.7
5/16/51	36 14	75 46	4391	103	36 40	75 51	27	9.0	3	28	9.1
5/16/51	36 12	75 45	4392	103	36 40	75 51	29	9.7	3	28.5	9.5
5/16/51	36 09	75 43	4393	103	36 40	75 51	32	10.1	3	37	12.3
5/16/51	36 15	75 46	4394	103	36 40	75 51	26	8.7	3	26.5	8.8
5/16/51	36 14	75 46	4395	103	36 40	75 51	26	8.7	3	26.5	8.8
5/16/51	36 14	75 46	4397	103	36 40	75 51	26	8.7	3	26.5	8.8
5/16/51	36 14	75 46	4398	103	36 40	75 51	26	8.7	3	26.5	8.8
5/16/51	36 12	75 45	4399	103	36 40	75 51	28	9.3	3	28.5	9.5
6/ 1/51	35 48	75 32	6058	105	36 22	75 23	34	1.9	18	40	2.2
6/15/51	35 24	75 29	6057	105	36 22	75 23	58	1.8	32	65	2.0
7/13/51	35 42	75 29	6067	105	36 22	75 23	41	0.7	60	45	0.8
7/13/51	35 46	75 31	6066	105	36 22	75 23	37	0.6	60	40	0.7
7/29/51	35 43	75 29	6059	105	36 22	75 23	39	0.5	76	44	0.6
5/28/51	35 35	75 27	6086	107	36 22	75 37	48	3.4	14	138	9.9
7/25/51	35 15	75 31	6091	107	36 22	75 37	67	0.9	72	103	1.4
5/15/51	36 05	75 42	5036	108	36 22	75 44	17	17.0	1	17	17.0
5/15/51	36 06	75 42	5037	108	36 22	75 44	17	17.0	1	16	16.0
5/15/51	36 06	75 42	5038	108	36 22	75 44	17	17.0	1	16	16.0
5/15/51	36 06	75 42	5040	108	36 22	75 44	17	17.0	1	16	16.0
5/15/51	36 03	75 41	5044	108	36 22	75 44	18	18.0	1	18.5	18.5
5/15/51	36 03	75 41	5045	108	36 22	75 44	18	18.0	1	18.5	18.5
5/16/51	36 05	75 41	5035	108	36 22	75 44	18	9.0	2	18	9.0
5/16/51	36 05	75 42	5039	108	36 22	75 44	17	8.5	2	16.5	8.2
5/16/51	36 05	75 42	5041	108	36 22	75 44	17	8.5	2	16.5	8.2
5/16/51	36 06	75 43	5042	108	36 22	75 44	15	7.5	2	16	8.0
5/16/51	36 05	75 41	5043	108	36 22	75 44	18	9.0	2	18	9.0
5/23/51	36 05	75 42	5034	108	36 22	75 44	17	1.9	9	17	1.9
5/16/51	36 15	75 47	5046	109	36 22	75 46	7	3.5	2	7.5	3.7
5/16/51	36 15	75 47	5047	109	36 22	75 46	7	3.5	2	7.5	3.7
5/16/51	36 14	75 46	5048	109	36 22	75 46	8	4.0	2	9	4.5

RECOVERY			RELEASE				MINIMUM DRIFT			ADJUSTED MIN. DRIFT	
Date	Lat. N °	Long. W °	Bottle	Sta.	Lat. N °	Long. W °	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d
5/16/51	36 14	75 46	5049	109	36 22	75 46	8	4.0	2	9	4.5
5/16/51	36 15	75 47	5050	109	36 22	75 46	7	3.5	2	7.5	3.7
5/16/51	36 15	75 47	5051	109	36 22	75 46	7	3.5	2	7.5	3.7
5/16/51	36 15	75 47	5052	109	36 22	75 46	7	3.5	2	7.5	3.7
5/16/51	36 16	75 47	5053	109	36 22	75 46	6	3.0	2	7	3.5
5/16/51	36 13	75 46	5054	109	36 22	75 46	8	4.0	2	10	5.0
5/16/51	36 16	75 47	5055	109	36 22	75 46	6	3.0	2	7	3.5
5/16/51	36 16	75 47	5056	109	36 22	75 46	6	3.0	2	7	3.5
5/16/51	36 16	75 47	5057	109	36 22	75 46	6	3.0	2	7	3.5
5/15/51	35 35	75 27	5095	112	35 47	75 29	13	13.0	1	12	12.0
5/16/51	35 34	75 27	5097	112	35 47	75 29	13	6.5	2	13	6.5
5/16/51	35 34	75 27	6096	112	35 47	75 29	13	6.5	2	13	6.5
5/28/51	35 35	75 27	5100	112	35 47	75 29	13	0.9	14	12	0.9
6/25/51	35 33	75 27	6093	112	35 47	75 29	14	0.3	42	14	0.3
7/17/51	35 35	75 27	5096	112	35 47	75 29	12	0.2	64	13	0.2
8/26/51	35 35	75 27	5099	112	35 47	75 29	12	0.1	104	13	0.1
7/ 4/51	32 14	65 50	5588	121	35 24	75 09	540	10.8	50	—	—
7/20/51	41 30	71 07	4543	134	35 25	74 22	397	5.5	72	—	—
6/20/51	36 00	75 38	4593	147	39 08	73 51	208	6.5	32	309	9.7
6/21/51	36 03	75 41	4596	147	39 08	73 51	205	6.2	33	305	9.2
6/17/51	36 03	75 13	4145	149	39 33	73 21	126	4.3	29	146	5.0
6/17/51	36 02	75 14	4141	149	39 33	73 21	130	4.5	29	146	5.0
7/ 5/51	37 09	75 51	4142	149	39 33	73 21	189	4.0	47	247	5.2
7/22/51	38 09	75 10	4144	149	39 33	73 21	123	1.9	64	150	2.4
8/14/51	38 00	75 15	4147	149	39 33	73 21	132	1.5	87	148	1.7
8/15/51	38 00	75 15	4148	149	39 33	73 21	132	1.5	86	148	1.7
6/16/51	39 36	74 12	4157	150	39 43	73 05	54	1.9	28	80	2.9
6/28/51	38 47	75 05	4154	150	39 43	73 05	111	2.8	40	120	3.0
7/20/51	38 00	75 15	4159	150	39 43	73 05	145	2.3	62	—	—
6/10/51	39 38	74 11	4163	151	40 00	72 46	68	3.2	21	106	5.0
6/15/51	39 16	74 33	4170	151	40 00	72 46	96	3.7	26	115	4.4
6/18/51	38 36	75 03	4164	151	40 00	72 46	138	4.8	29	195	6.7
6/18/51	38 20	75 05	4169	151	40 00	72 46	151	5.1	29	211	7.2
6/20/51	38 17	75 06	41 67	151	40 00	72 46	151	4.9	31	195	6.3

RECOVERY				RELEASE				MINIMUM DRIFT				ADJUSTED MIN. DRIFT	
Date	Lat. N ° ' "	Long. W ° ' "	Bottle	Sta.	Lat. N ° ' "	Long. W ° ' "	Miles drifted	Velocity mi/day	Days Adrift	Miles drifted	Vel. m/d		
6/26/51	38 36	75 03	4161	151	40 00	72 46	137	3.7	37	195	5.3		
6/24/51	38 07	75 10	5848	152	40 25	72 20	195	5.6	35	240	6.9		
6/22/51	38 58	74 49	5834	153	40 36	72 07	162	4.9	33	190	5.8		
6/21/51	39 20	74 28	4122	154	40 54	71 46	156	4.9	32	192	6.0		
8/26/51	38 10	75 09	5397	15	40 20	73 14	161	109	1.5	176	1.6		
8/29/51	35 35	75 27	6099	112	35 47	75 29	12	107	0.1	13	0.1		
9/ 3/51	37 16	76 01	4643	22	39 42	73 35	213	116	1.8	289	2.5		

DISTRIBUTION LIST

Contract N6onr-27701 (NR-083-004)

- | | | | |
|---|--|---|---|
| 1 | Commanding Officer
Air Force Cambridge Research
Center
230 Albany Street
Cambridge 39, Massachusetts | 1 | Chief, Bureau of Yards and
Docks
Department of the Navy
Washington 25, D. C. |
| 2 | Chief, Bureau of Ships
Department of the Navy
Washington 25, D. C.
Attn: Code 847 | 1 | Director
Chesapeake Bay Institute
Box 26A
R. F. D. #2
Annapolis, Maryland |
| 3 | Chief of Naval Research
Department of the Navy
Washington 25, D. C.
Attn: Code 416 | 1 | Commandant
U. S. Coast Guard
1300 E Street, N. W.
Washington, D. C.
Attn: Aerology & Oceano-
graphic Section |
| 1 | Commanding General
Research and Development Division
Department of the Air Force
Washington, D. C. | 1 | Commanding General
Research and Development Div.
Department of the Army
Washington, D. C. |
| 1 | Commanding Officer
Branch Office of Naval Research
150 Causeway Street
Boston 14, Massachusetts | 1 | Commanding Officer
Branch Office of Naval Research
844 North Rush Street
Chicago, Illinois |
| 1 | Commanding Officer
Branch Office of Naval Research
346 Broadway
New York 13, New York | 1 | Commanding Officer
Branch Office of Naval Research
1030 East Green Street
Pasadena 1, California |
| 1 | Commanding Officer
Branch Office of Naval Research
1000 Geary Street
San Francisco 9, California | 1 | Commanding Officer
Naval Ordnance Laboratory
White Oak
Silver Spring 19, Maryland |
| 1 | Director
Lamont Geological Observatory
Torrey Cliff
Palisades, New York | 1 | Director
U. S. Coast and Geodetic Survey
Department of Commerce
Washington 25, D. C. |
| 9 | Director
Naval Research Laboratory
Washington 25, D. C.
Attn: Technical Services | | |

DISTRIBUTION LIST (Cont'd.)

8 Hydrographer U. S. Navy Hydrographic Office Washington 25, D. C. Attn: Division of Oceanography	1 Head Department of Oceanography Texas A & M College Station, Texas
1 Naval War College Newport, Rhode Island	1 National Research Council 2101 Constitution Avenue Washington 25, D. C. Attn: Committee on Undersea Warfare
2 Assistant Naval Attache for Research American Embassy Navy Number 100 Fleet Post Office New York, New York	1 Research and Development Board National Military Establishment Washington 25, D. C. Attn: Committee on Geophysics and Geography
2 Director Scripps Institution of Oceanography La Jolla, California	1 Director Department of Engineering University of California Berkeley, California
1 Director Marine Laboratory University of Miami Coral Gables 34, Florida	1 Head Department of Oceanography University of Washington Seattle 5, Washington
2 Director U. S. Navy Electronics Laboratory San Diego 52, California Attn: Codes 550,552	1 The Oceanographic Institute Florida State University Tallahassee, Florida
1 Librarian U. S. Geological Survey General Services Administration Building Washington 25, D. C.	1 U. S. Fish & Wildlife Service P. O. Box 3830 Honolulu, T. H.
1 Chief of Naval Research Department of the Navy Washington 25, D. C.	1 U. S. Fish & Wildlife Service Woods Hole, Massachusetts
1 Director Narragansett Marine Laboratory Kingston, Rhode Island	

DISTRIBUTION LIST (Cont'd.)

- 1 Bingham Oceanographic Foundation
Yale University
New Haven, Connecticut
- 1 Department of Conservation
Cornell University
Ithaca, New York
Attn: Dr. J. C. Ayers
- 2 Director
U. S. Fish & Wildlife Service
Department of the Interior
Washington 25, D. C.
Attn: Dr. L. A. Walford
- 1 U. S. Army Beach Erosion Board
5201 Little Falls Road, N. W.
Washington 16, D. C.
- 1 Allen Hancock Foundation
University of Southern California
Los Angeles 7, California
- 1 U. S. Fish & Wildlife Service
Fort Crockett
Galveston, Texas
- 1 U. S. Fish & Wildlife Service
450 B Jordan Hall
Stanford University
Stanford, California
- 1 Director
Hawaii Marine Laboratory
University of Hawaii
Honolulu, T. H.
- 1 Head
Department of Oceanography
Brown University
Providence, Rhode Island
- 1 Department of Zoology
Rutgers University
New Brunswick, New Jersey
Attn: Dr. H. H. Haskin